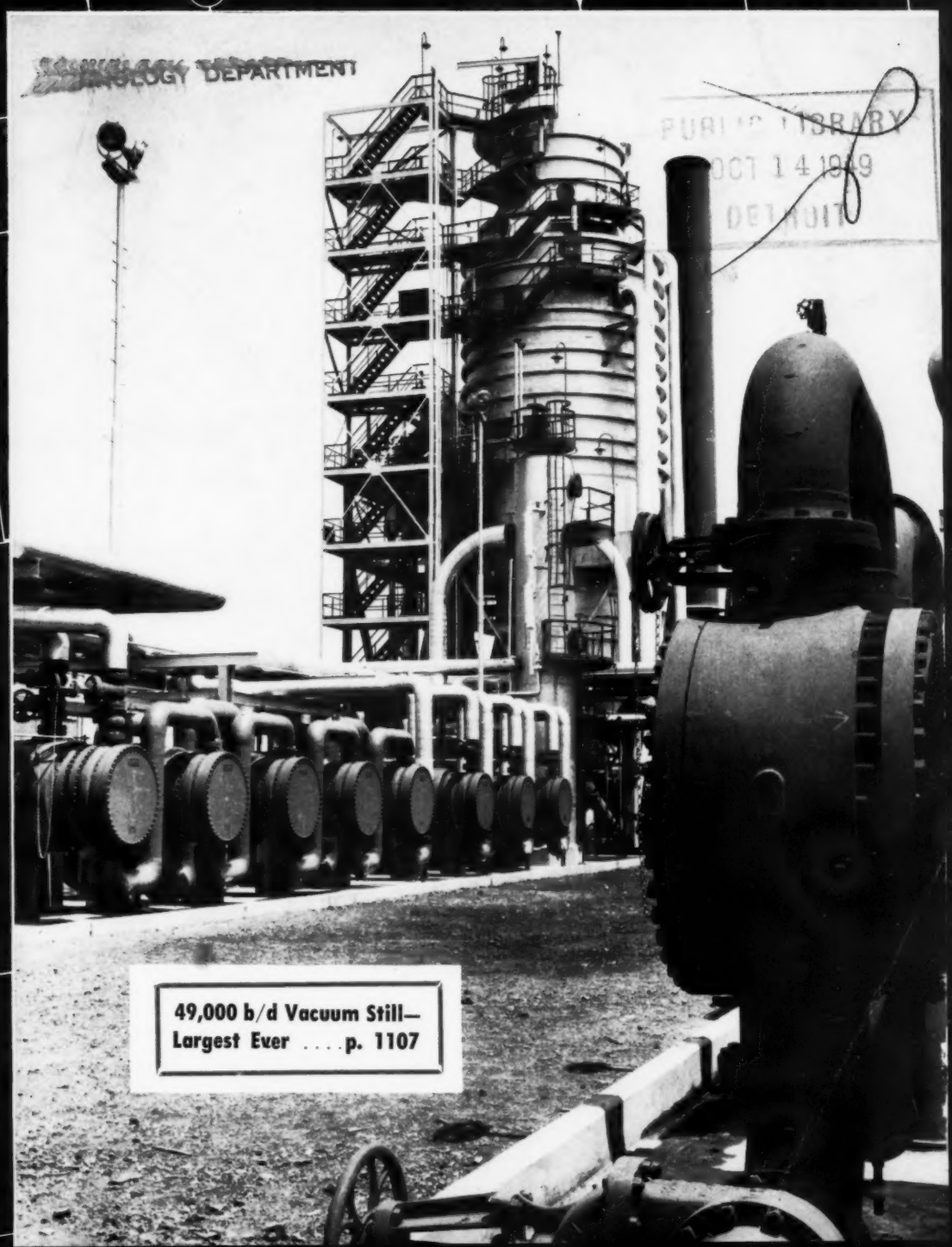
OCTOBER, 1949
VOL. 4, NO. 10

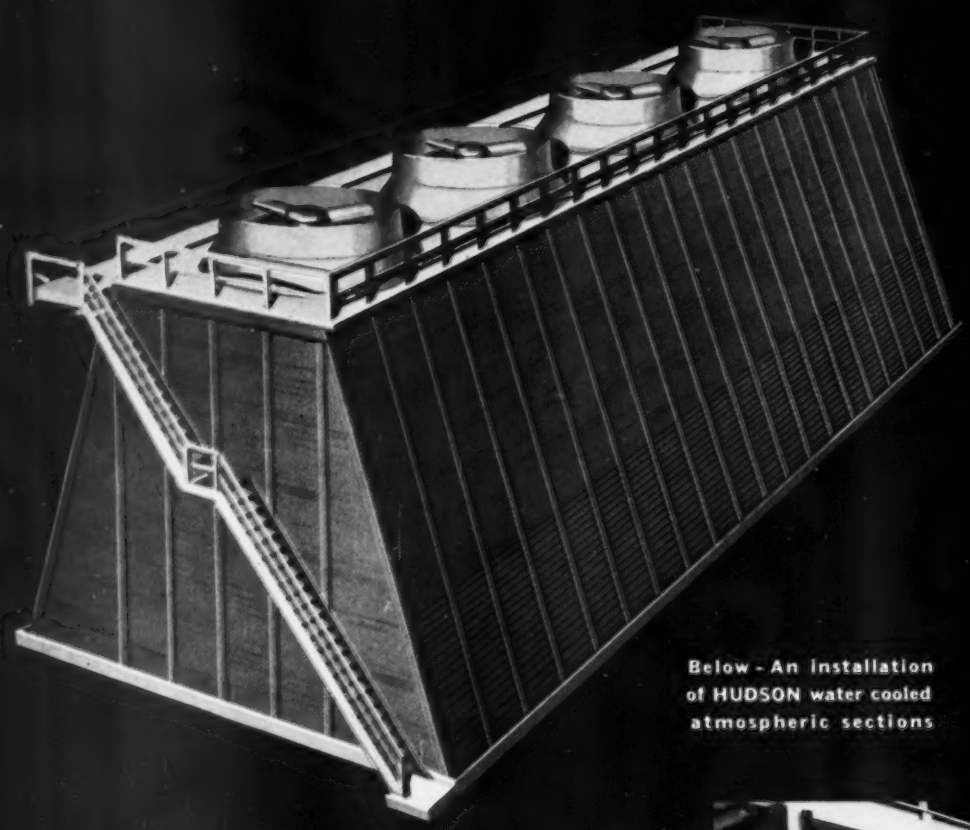
PETROLEUM PROCESSING



49,000 b/d Vacuum Still—Largest Ever . . . . p. 1107

NEW HUDSON

Top Performance COOLING TOWERS



Below - An installation of HUDSON water cooled atmospheric sections

1 IMPROVED AIR FLOW AND AIR-WATER CONTACT

Unique deck design reduces air pressure drop and establishes positive counter current contact between air and water. Tapered sides of the tower eliminate dead space and decrease air turbulence.

2 LOWER OPERATING COST

Low pumping head and low fan horsepower result in perpetual power savings.

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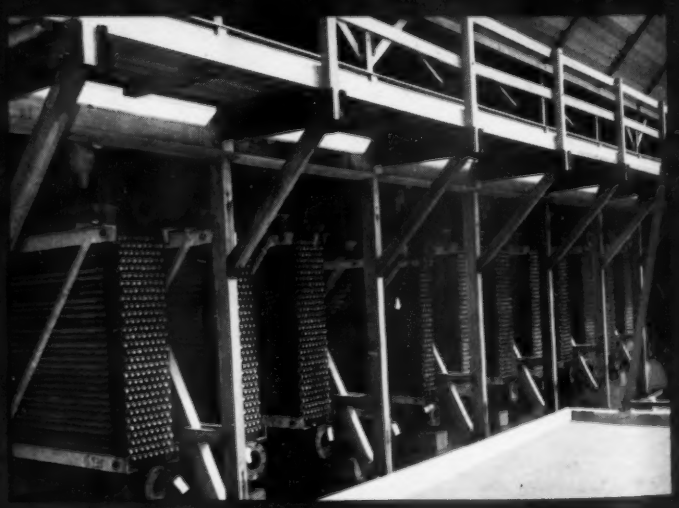
Prefabricated sections are designed for mass production and easy field assembly.

4 GREATER STRUCTURAL STRENGTH

Bridge truss type framework with improved timber connectors develops maximum strength in load bearing members.

Undivided Responsibility

Complete integration in selection and design of cooling tower with coolers, results in cooling systems of minimum first cost and minimum operating cost... and the responsibility is undivided.



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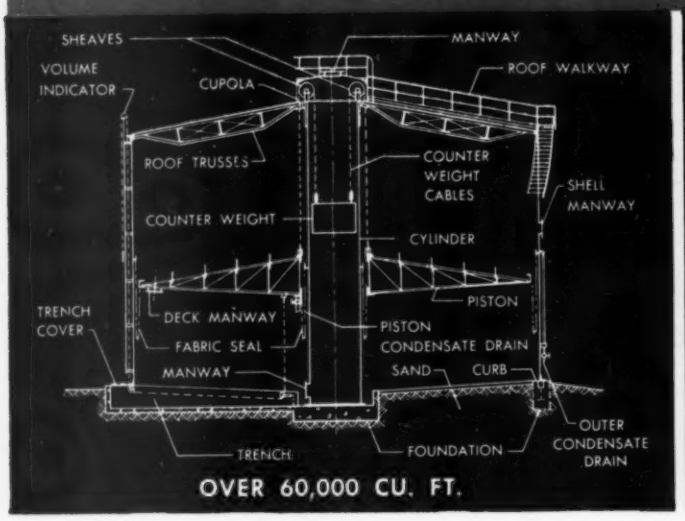
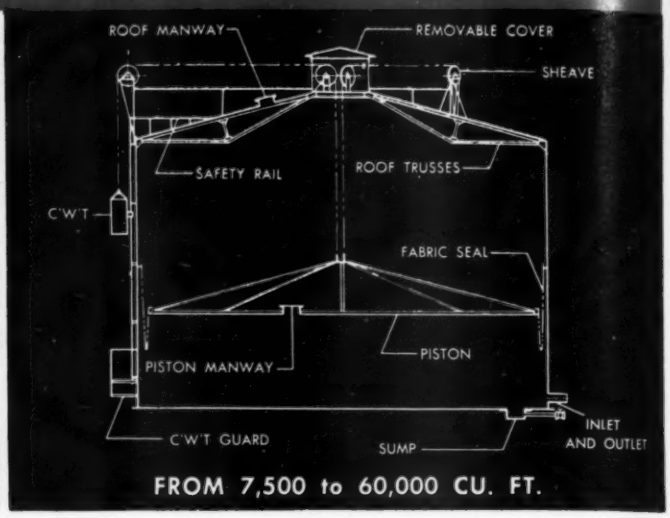
WIGGINS *Dry Seal* GASHOLDERS



OVER 60,000 CU. FT.



FROM 7,500 to 60,000 CU. FT.

have proved a profitable investment,

because they offer . . .

1. A Gasholder with efficient operation and easy maintenance.

a. Not affected by snow load since all moving parts are under cover.
b. All major moving parts accessible for inspection during operation.
c. A vapor balancer that can be made gas free for repairs in a few hours.
d. A vapor seal that has a life equal to that of the tank.
e. A Gasholder working pressure of ⅛ to ¼ inch of water.

2. A vapor balancer that has a 100% Dry Seal.

a. Eliminates corrosion problems attendant with wet seals.
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c. Has no evaporation loss through a water or oil seal.
d. Requires no attention, adjustment or lubrication.

3. One vapor balancing mechanism for all tanks.

a. Provides flexibility of operation.
b. Permits repair of any tank in group without affecting operation.
c. Allows vapor balancer to be removed without disturbing storage tank operation.
d. Accomplishes all venting through one master valve.
e. One structure for protection of all standing and pumping loss.

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Dry Seal Lifter Roof
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Dry Seal Gasholder
Improved Balloon Roof

For more complete details and Pay-Out Analysis, write for Bulletin VB-10

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NATIONAL PETROLEUM NEWS
The weekly oil marketing magazine, covering news, prices, transportation, storage, merchandising

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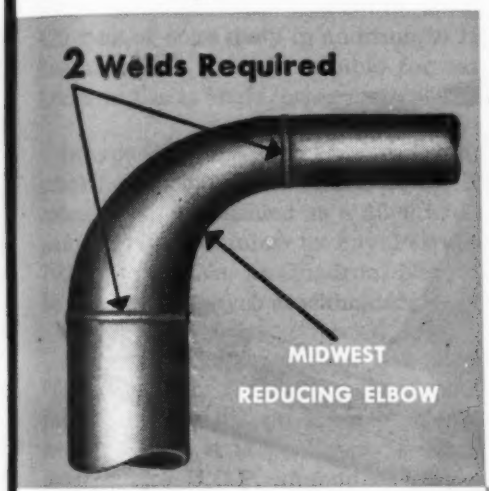

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WHEN PERFORMANCE COUNTS . . . CALL ON CYANAMID

What's Happening!

Important Current News Summarized for Refiners

EXPANSION

Pan-Am Southern Corp. will install a 9300 b/d delayed coker and related equipment at its El Dorado, Ark., refinery. Coker includes two 17.5-ft. by 80-ft. vertical drums with hydraulic decoking, producing 420 tons of coke daily in addition to 1900 b/d of gasoline and 5200 gas oil suitable for catalytic cracking. Lummus Co. is engineering contractor.

Grayco Oil & Refining Co. is planning to add thermal cracking and other facilities at its Newcastle, Wyo., refinery, now classified as a 2500 b/d skimmer. Company also is planning to buy Petroleum Utilities Co. 700 b/d skimmer at Chadron, Neb. Two plans must be OK-ed by Grayco stockholders.

Universal Oil Products Co. has purchased more than 600 acres near Shreveport as a plant site to manufacture "specialty products." No other details are available, but it is pertinent to remember that some months ago U.O.P. announced that it was manufacturing a new anti-oxidant chemical on a commercial scale in Chicago—the firm's first venture into the manufacturing field. The anti-oxidant is finding application in keeping animal fats and vegetable oils from turning rancid.

Richfield Oil Co. reportedly is going to install a 100 b/d Lummus continuous contact coking unit at its Watson, Calif., refinery. Although small, this unit will be the first commercial plant using this new process.

Old Dutch Refining Co., Muskegon, Mich., is installing the first of another new type process—Universal Oil Product's Platforming, for catalytic reforming of straight run naphthas and gasoline. The unit is now under construction, and expected to be operating next month.

Imperial Oil Co. has purchased a 400-acre site on the outskirts of Winnipeg, Manitoba, for a new refinery. Size of the plant, now being designed, hasn't yet been announced.

Shell Oil of Canada has started construction at its Montreal, Quebec, refinery to increase crude throughput 80%. Units being added include 12,000 b/d vacuum distillation, 10,000 b/d modified UOP Fluid catalytic cracking and related facilities, revamped Dubbs cracking and light distillate treating, plus additional boiler and water treating capacity. A. G. McKee & Co. is building the new units and Fluor Corp. the auxiliary facilities, with both Fluor and Shell personnel doing the revamping.

British American Oil Co. has contracted with Canadian Kellogg, Ltd., for a 700 b/d propane deasphalting unit at its Clarkson, Ontario, refinery, to complete its solvent lube refining facilities. Initial operation is slated for mid-1950.

California Refining Co. will include a 25,000 b/d Houdriflow catalytic cracking unit in the expansion of its Perth Amboy, N. J., plant, according to Houdry Process Corp., licensor of the process.

Capacity of oil refineries in Canada's prairie provinces (Saskatchewan, Manitoba, Alberta) will be increased by more than 33-1/3% to a total of approximately 90,000 b/d by 1951, according to a forecast made by Interprovincial Pipe Line Co., affiliate of Imperial Oil Ltd. Prediction was contained in a prospectus covering sale of bonds for Interprovincial's 1150-mile pipe line from Edmonton to Great Lakes.

• • •

FOREIGN

Esso Standard Refinery, subsidiary of Standard Oil Co. (New Jersey), will build a 25,000 b/d refinery at Antwerp, Belgium. Completion will take three years and products will serve Jersey affiliates in Belgium, the Netherlands and Luxemburg.

Venezuela Gulf Refining Co. expects to begin operations at its 30,000 b/d refinery at Puerta La Cruz, Venezuela, in July 1950, using the Polyform process to crack heavy gas oil with high gas dilution (first commercial operation for this application). The $50-million plant will produce approximately 11,000 b/d gasoline, 7600 b/d No. 2 fuel and Diesel oil and 10,500 b/d residual fuel for sale in world markets. Company is two-thirds owned by Gulf, balance by Texaco.

Economic Co-operation Administration will help finance (to extent of about 15%) five refinery expansion projects in Britain and France costing a total of more than $150-million: Shell Refining & Marketing Co. at Shell Haven, increase present 8000 b/d capacity to 66,000 b/d; National Oil Refineries (Anglo-Iranian subsidiary) at Llandarcy, increase present 7500 b/d capacity to 43,000 b/d, and lube output from 50,000 to 100,000 metric tons per year; Compagne de Raffinage Shell Berre at Berre, increase present

Information on these pages is obtained through the nation-wide news coverage services of PLATT'S OILGRAM NEWS

capacity from 20,000 b/d to 30,000 b/d, and lube capacity from 20,000 metric tons per year to 35,000; Notre Dame de Gravenchon refinery of Socony-Vacuum Francaise, increase lube capacity to 50,000 metric tons annually; Port Jerome refinery of Standard Francaise des Petroles (Jersey Standard affiliate), improve and expand lube facilities to 139,000 metric tons annually.

Total refinery throughput outside North America and Eastern Europe will increase from 2,424,000 b/d in 1948 to 4,230,000 b/d in 1953, if present expansion plans of British, Dutch, American and other companies should be realized, according to a statistical summary released by Economic Co-operation Administration.

• • •

NATURAL GASOLINE

Richfield Oil Corp. will build a $4,500,000 natural gasoline plant near Cuyama, Calif., producing LPG and natural gasoline. Construction, by Fluor Corp., Ltd., will begin by mid-October.

Midland Gasoline Co. has put its 100,000 gal. gasoline plant near Conroe, Texas, on stream at double former capacity. Gasoline Plant Construction Co., Houston, was contractor. Plant recovers LPG and natural gasoline, sells dry gas to United Gas Co.

The jointly owned 60,000 gal. natural gasoline plant being constructed by Continental Oil Co. for 22 other operators in the Deep Todd pool of Crockett Co., West Texas will be completed Nov. 1. All the pool gas, 10,000 Mcf., will be processed in this plant; Refinery Maintenance Co. is engineering contractor.

• • •

MARKETS, PRICES

Upward trend in light and heavy fuel prices which got under way in August continued throughout September in most refinery and terminal markets. Gasoline was steady in most areas. Aside from a reduction in California heavy crudes, the fourth to date in 1949, crude oil markets generally were unchanged.

Cut in California crude again emphasized overproduction of fuel oil-bearing crudes which has plagued the area for more than a year. Low gravity crudes were dropped in amounts ranging from 3c to 35c per bbl., carrying prices for the lowest gravities in some fields to below $1.00 per bbl. Signal Hill 18 gravity oil was off 25c to $1.53.

Standard of Indiana abandoned use of group 3 prices plus rail freight in determining its wholesale prices for refined products throughout its 11-state marketing territory. Basing of prices on local competition, resulting from more economical transportation, was adopted. Reduction of 0.3c per gal., average, was made in the company's tank wagon gasoline prices. Refinery markets in the Mid-Continent and midwest did not reflect this cut, and gasoline prices in other primary supply areas generally were unchanged.

In Canada, Imperial Oil advanced its crude postings 20c and 25c per bbl. in some fields following 10% devaluation of the Canadian dollar, lending strength to speculation that oil prices in non-dollar areas generally will be increased to compensate for devaluation of the pound sterling.

• • •

MISCELLANY

Oil mining on an experimental basis for research purposes was suggested last month by Paul D. Torrey, Houston, chairman of the Interstate Oil Compact Commission's Secondary Recovery Advisory Committee. In a report to the Commission, Torrey stated that under certain reservoir conditions "it appears likely that mining will result in a greater recovery of oil than can be obtained by the application of any generally practiced secondary recovery method."

Research expenditures of petroleum industry are now $100-million annually, according to Dr. Wayne E. Kuhn, manager of technical and research division of The Texas Co. Speaking at recent meeting of American Chemical Society in Atlantic City, Dr. Kuhn estimated that present amount spent by oil companies for research is four times greater than ten years ago, and that ratio of research expenditures to sales has almost doubled since 1939.

World production capacity for lubricating oils will exceed world demand for many years to come, according to Paul Keyser, Jr., manager of Socony-Vacuum's lubricating department. (See pg. 1091 for full report.)

• • •

TRANSITION

Olympic Refining Co.'s 6500 b/d refinery at Long Beach, Calif., has been leased by the Rothschild Oil Co., major supplier of self-service stations in that area. Rothschild now has acquired three refineries, and has a total capacity of 20,000 b/d.

Hamman Oil & Refining Co. has shut down its 2100 b/d plant at Bay City, Texas, as result of price "squeeze" between crude cost and product realizations.

Denver Producing & Refining Co.'s 2000 b/d skimming plant near Edmond, Okla., has been sold to United States Pipe & Supply Co. of Edmond. Plant has been shut down since last May because company was unable to move residuum "at current prices."

An Idea ...THAT WENT TO WORK!

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AT WOOD RIVER PIPELINE STATION

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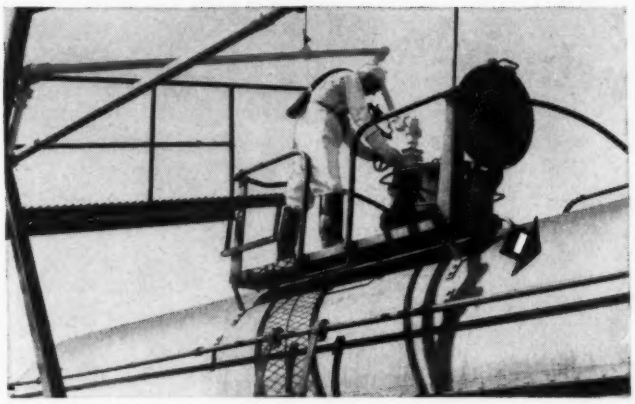
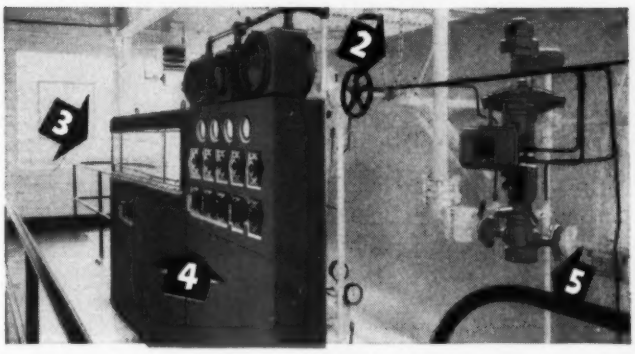
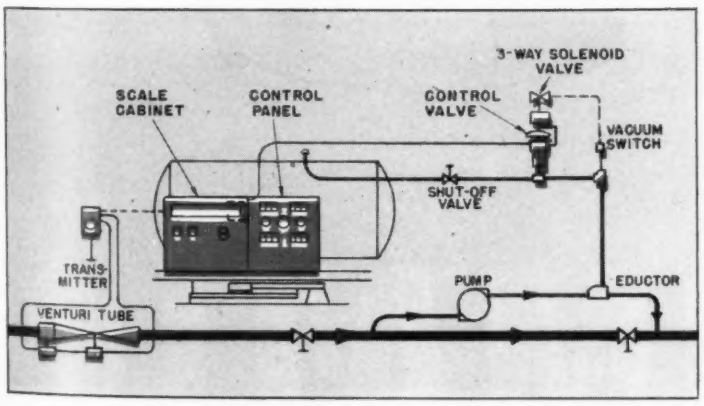


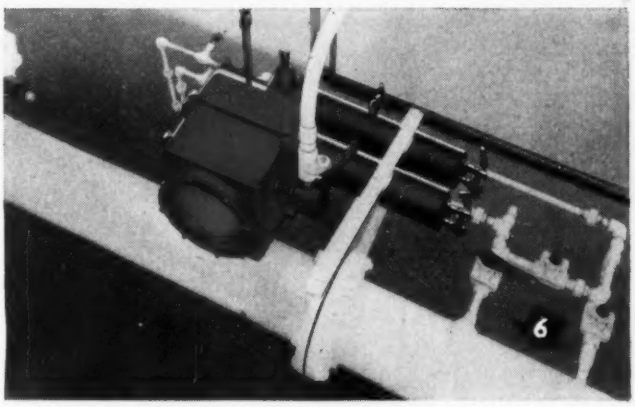
1—T.E.L. Fluid is drawn under vacuum from tank car.



2—Fluid storage tank on standard scale. 3—%Proportioneers, Inc.% Automatic and Flow Responsive Loss-In-Weight Proportioning Scales. 4—Complete alarm panel fully protects system. 5—Specially designed Diaphragm Control Valve for T.E.L. Fluid.



All equipment shown red in photos and flowgram furnished by %Proportioneers, Inc.%



6—Venturi Meter measures gasoline flow through pipeline and maintains uniform pre-set lead treatment.

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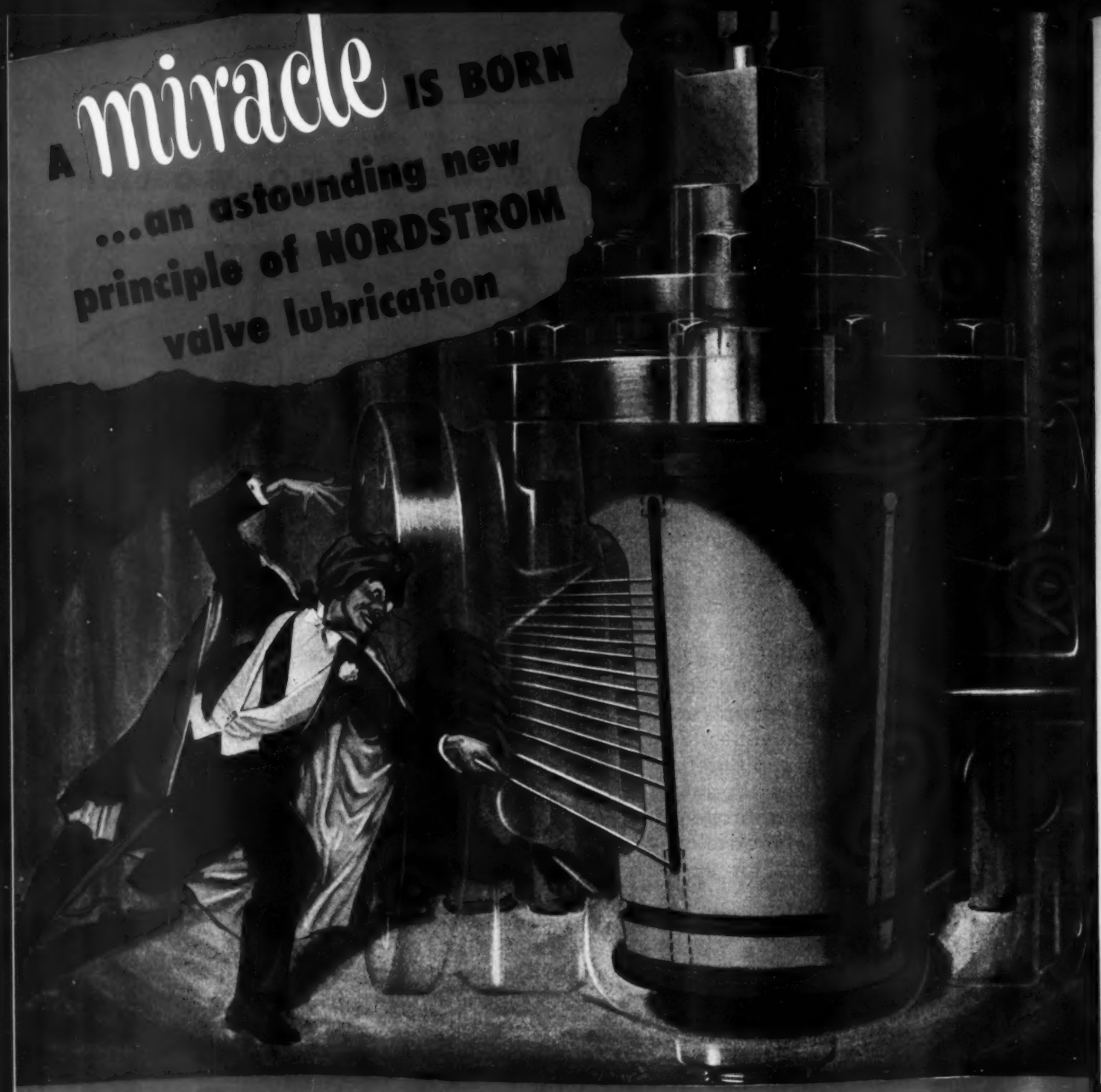

AUTOMATIC

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SELF-ACTING

SELF-THINKING

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Greatest improvement in history of Nordstrom valves

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Keeps Nordstrom valves in state of perfect lubrication

AN *energizable* LUBRICANT

to seal Nordstrom valves automatically and continuously

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Now you can make deep cuts in your valve maintenance cost because your lubrication crew need devote only 1/10, 1/20, 1/50, up to 1/100 as much time to re-lubrication.

Your Nordstrom valves will give better service with less cost because each one will be automatically maintained in a condition of 100% lubrication, even in event of considerable neglect.

Leakage will be prevented because Hypermatic both seals and lubricates with split-second action and positive certainty.

Unlike any other lubricant, Hypermatic is compressible and expansible. Self-powered energy is created within the lubricant merely by turning the lubricant screw or using a grease gun. This energy then serves as a powerful force-feed. Almost twice as much Hypermatic can be compressed into the valve's lubricant chambers. The pressure is retained, not for days, but for months, if the valve is not operated. If frequently operated, Hypermatic will retain its pressure for scores of turns longer than if non-automatic lubricant is used.

NOTHING TO BUY EXCEPT THE LUBRICANT

Instead of resorting to the use of extraneous devices or endeavoring to use variable line pressure, Hypermatic provides a new system of lubrication which gives the effect of a vastly improved valve design. You don't have to invest a single cent in mechanical devices. You don't even have to purge the old lubricant. Simply switch to Hypermatic and apply it to your present Nordstrom valves. It will displace the old lubricant.

Your Nordstrom valves will use less Hypermatic than non-automatic lubricant because Hypermatic creates, by its flexible nature, a "spring-action" which to a great extent prevents over-lubrication and under-lubrication.

IT COMPRESSES

Like the action of a door-check, Hypermatic compresses to a fraction of its volume when the lubricant is forced in. This stores up energy for future use.

ROCKWELL

Hypermatic

TRADE MARK

LUBRICANT

PATENT APPLIED FOR

IT EXPANDS

When the valve needs lubricant to seal a leak, its inherent energy forces it to expand and seal the valve seat. It feeds into any void instantly.

FOR NORDSTROM VALVES

LUBRICATION

MAN-HOURS SAVED

TWICE THE STORAGE

MULTIPLIED VALVE LIFE

GALLING ELIMINATED

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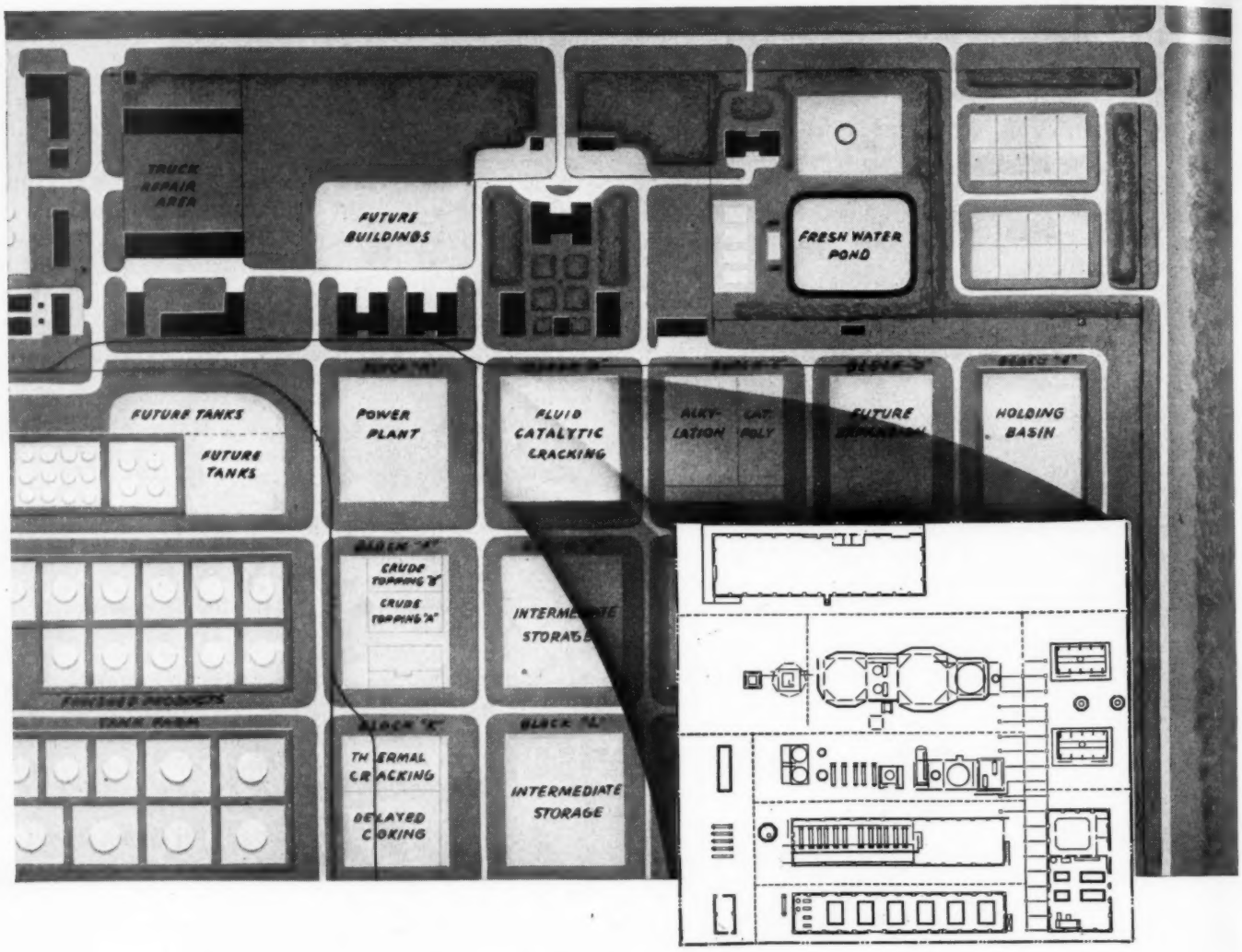

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Tomorrow
... IN PETROLEUM TECHNOLOGY

By B. H. WEIL, Atlanta, Ga.
Editor, "Monthly Summary of Industrial Developments"

Brief reviews of currently reported technological and economic developments, in the light of their potential bearing on petroleum refining

Alkylation Plant Goes Back On-Stream

DURING the recent war, the alkylation of hydrocarbons (chiefly isobutane) with olefins (chiefly butylenes) was *the* process on which the production of high-octane aviation gasolines depended. Plant after plant was erected for the production of alkylates, and by the end of the war the annual production of alkylate exceeded that of any other organic chemical.

After the war, however, the story is equally well known. Aviation gasoline demand plummeted. Economics entered the picture — alkylation plants, apparently, could not be economically operated for the production of blending materials for motor fuels. Alkylation plants were shut down, or their components were cannibalized for use in other processes.

Alkylation of isobutane with butylenes was not the only isoparaffin alkylation process used commercially during the war, however. As is common knowledge, the Phillips Petroleum Company, before the war, placed in operation a plant for the thermal alkylation of isobutane with ethylene to yield neohexane (2,2-dimethylbutane), and in 1944 this same company began operation of a plant at Phillips, Texas, for the catalytic (aluminum chloride) alkylation of isobutane with ethylene to yield diisopropyl (2,3-dimethylbutane).(1) Nor was Phillips the only one which had investigated this latter process on the pilot-plant scale.(2)

These plants, apparently, suffered the same economic fate as those which employed butylenes as the alkylating olefins, but what *is* news—and highly intriguing at that—is the recent announcement that Phillips has put back on stream "its newly modernized catalytic ethylene alkylation unit at Phillips, Texas, for the production of diisopropyl." This unit, as mentioned above, is "the only plant of its kind for the commercial manufacture of this product."(3)

No details as to why operations were resumed at this time were released, although presumably this high-octane blending agent will be used for premium gasoline production. It should be noted, incidentally, that diisopropyl is second only to triptane among known agents in its high knock rating under rich-mixture supercharge conditions.

Phillips did state that the plant has been extensively modernized since operations were halted shortly after the end of the war. What that entailed can only be guessed until Phillips sees fit to describe present operations. It is possible, however, that some such catalyst as the BF_3-H_2O-HF complex may have been substituted for the wartime $AlCl_3$-hydrocarbon complex catalyst, since Phillips has reported research on such a substitution.(4)

In any event, it may well be assumed that alkylation economics are getting a thorough going-over by many petroleum companies. While research on alkylation processes has certainly tapered off materially from its wartime peak, it would not be surprising if a combination of technical advances and changing economics would serve to rescue a technically excellent, thoroughly proved process from the limbo of discarded methods.

Smokeless Fuels Potential Market for Petroleum Coke

WHAT with the present and potential emphasis on means of converting heavy residuals to lighter and more marketable products—occasioned by the growing surplus of residual fuel production—it appears inevitable that the petroleum industry must turn increased attention toward the marketing of by-products produced in the operations selected for use. At present, at least, coking is the method being selected by most refiners, meaning that here the by-product which will be available in increasing quantities is petroleum coke.

To some extent, this increased output of coke may be absorbed by present uses—manufacture of carbon electrodes, dry-battery anodes, metallurgical abrasives, in aluminum and magnesium manufacture, etc., but it seems almost certain that the ultimate answer will lie in its use as fuel—at the refinery or elsewhere.

Coke from batch coking stills such as Knowles coke ovens is known to stand transport well and to be suitable for industrial use in lump form. While increased consumption by this market is a definite possibility, it seems quite likely that another use may attract even more attention—the manufacture of smokeless fuels, which are in increasing domestic and industrial demand in localities which are placing increased emphasis on smoke abatement.

It is significant to note that this field, hitherto well within the domain of the coal industry, already gives signs of yielding to petroleum coke infiltration. In a "Directory of Packaged Fuel Operations in the United States Which Reported Production in 1948," the Bureau of Mines (in its MMS No. 1721) lists four plants whose products contain petroleum coke, usually compounded with semianthracite coal.

Petroleum coke has many outstanding properties, all of which will be put to the test within the very near future. Coking will not be a very economic refinery operation if a reasonable market is not available for the vast quantities of petroleum coke produced as the unavoidable by-product.

Coal Hydrogenation Plant Rumored Under Construction

IN its recent survey on "High Pressure" reactions,(5) *Chemical Engineering* reports that "trade sources say that Carbide (Carbide and Carbon Chemicals Corp.) has authorized an $8,000,000-$10,000,000 plant to be installed at Institute, West Virginia, for coal hydrogenation. It may be that Carbide expects to develop a new organic field—multi-ring compounds. The oil from coal hydrogenation is full of naphthenic, anthracenic, and other multi-ring compounds. The previous supply of these has been solely the small amounts contained in coal tar from coking."

If this rumor is correct, it may prove another instance in which Carbide's foresighted research — and close-mouthed policy—has enabled it to "get the jump" on the field. Carbide's petrochemical history is already almost legend—its ethylene glycol, glycol derivatives, alcohols, esters, ethers, synthetic resins, synthetic lubricants, etc., have long since placed it in the forefront of those chemical companies allied to the petroleum field. Moreover, as reported recently in this series, rumor also has it that Carbide is experimenting on a

large scale with underground gasification of coal, possibly in the search for a low-cost source of hydrogen for coal hydrogenation. This combination certainly lends some substance to both rumors.

It is a well known economic fact that chemical by-products from synthetic fuel processes—coal hydrogenation, the Synthine (Fischer-Tropsch) process, etc.—will be a drug on the market after and if many large-scale hydrocarbon synthesis plants are erected. In the interim, however, the first few plants for any given process can probably count on a profitable market for chemical by-product materials and can include appropriate calculations based on this in their amortization and product cost figures.

This is certainly the case for the nearly completed Synthine plant of Carthage Hydrocol, but what is intriguing in the event that Carbide is actually building a coal hydrogenation unit is the fact that—if *Chemical Engineering's* guess is correct, as seems probable—this unit will be intended primarily for the production of chemicals, since Carbide is a chemical company, not a producer of liquid fuels. Such gasolines and fuel oils as are produced—after their valuable chemicals are separated—will be the real by-products in this instance.

Coal hydrogenation is by now a much-explored process, as witnessed by the thousands of patents and articles concerning its various phases. German commercial operations, moreover, have yielded much information as to what to do, what not to do, etc. Bureau of Mines' research in this field has been extensive—too extensive, according to some critics, who believe that the Synthine process has and will maintain an economic lead as regards the synthesis of liquid fuels from coal. Whatever the case, the event of the first commercial coal hydrogenation plant in this country will be watched with vast interest by the petroleum industry, even if operations are slanted heavily toward chemicals production.

Nylon Production Continues to Increase

NO synthetic product in chemical history—the antibiotics possibly excepted—has ever captured the public's attention with as much glamor as has nylon, "the wonder fiber" (and plastic). Today, 87.6% of all women's full-length hosiery is made of nylon, and the textile industry continues to clamor for more for use in the manufacture of shirts, dresses, blouses, swim suits, socks, furniture, automobile upholstery, umbrellas, underwear, and luggage. According to trade sources, output has failed to keep up with increasing demands, although Du Pont produced approximately 48,000,000 lbs. of nylon in 1948, will produce approximately 70,000,000 lbs. in 1949, and may be able to increase its output to 90,000,000 lbs. next year.

It is reported, moreover, that Du Pont is considering licensing rayon yarn producers to produce nylon. While basic nylon patents do not expire until 1955, it is believed that this action might be predicated upon the desire to disprove Government claims of too-great "concentration of industrial power." Chief obstacle to the erection of plants by other companies, under license, is said to be the size of the capital investment required.

Moreover, other synthetic fibers seem certain to offer near-future competition to nylon. Du Pont's own orlon, which will be in commercial production next year at a plant in Camden, South Carolina, has many noteworthy properties, including somewhat lower costs than nylon. In addition, Du Pont has several other fibers in the developmental stage, including the much-rumored "Fibre V"; an acrylic fiber is under joint development by the Monsanto Chemical Corp. and the American Viscose Corp.; the Celanese Corp. has its "super-rayon," Celcos; etc.

While Du Pont is expanding its yarn spinning and processing equipment at Chattanooga, Tennessee; is adding facilities for staple production at Seaford, Delaware; and is constructing a nylon salt plant at Victoria, Texas, for synthesis from butadiene, it is said that the company has no plans for the moment for building other plants.

However, this must not be taken to mean that Du Pont is resting on its laurels as regards nylon. The Seaford, Delaware, nylon staple plant now under construction is proof enough of this. Du Pont has conducted extensive research and development on the production of nylon stapled fibers for spinning on cotton system machinery, in order that nylon—like rayon before it—may leave the monofilament field and enter into many new uses. It may well be assumed that fabrics made from the new nylon stapled fibers will lack some of the few faults of those produced from the monofilaments—better holding at seams, etc.

While nylon is only now becoming a real petroleum derivative, by virtue of the Victoria, Texas, plant, its synthesis has long been based on chemicals which can be produced from petroleum intermediates. It is to be expected, then, that individuals in the petroleum field will have a continued interest in a substance which is glamorous by virtue of its properties as well as the publicity bestowed upon it.

Masking of Odors Including Petroleum

IN a recent discussion of the principles of odor masking(6) E. C. Crocker of Arthur D. Little, Inc., points out that "masking of odors is most satisfactory when it produces an odor of minimum obviousness rather than one of distinct pleasantness," especially since it is "mostly the covering of 'stinks'—odors which are not wanted, whether inherently pleasant or otherwise . . .

On the subject of petroleum Crocker cites a 1947 survey which revealed that kerosene was second on the list of most disliked odors, with gasoline in eighth place.

According to Crocker, "odor prevention is often possible through the use of preservatives of one type or another, such as antioxidants for fats and oils, mold inhibitors, and antiseptics. Odors may be transient and need coverage for only a period . . . In other instances, especially with petroleum oils and certain fats and soaps, objectionable odors appear only after an initial 'induction period'."

In his discussion, Crocker mentions that while "present-day flysprays start with relatively low-odor kerosenes," they "still need masking to cover the odor of the active insecticides. Insecticide odors have to be breathed, so should be as free as possible from toxic and irritating substances."

As Crocker points out, "the quantity of agent necessary to neutralize an objectionable odor, but not to create a perfume, is generally less than one part in 1,000 and may be as little as one part in 20,000, depending on the odor to be covered. Flyspray odorant compositions, to be used in the amount of one ounce in ten gal. of refined petroleum, cost $2 to $5 per lb. This figures out to 1.2 to 3.1 cents per gal. of finished product . . .

"There is no universal deodorizing material for incorporation into manufactured goods. The masking business depends, in the last analysis, upon the art and skill of the odor-blender, drawing upon a wide variety of available materials."

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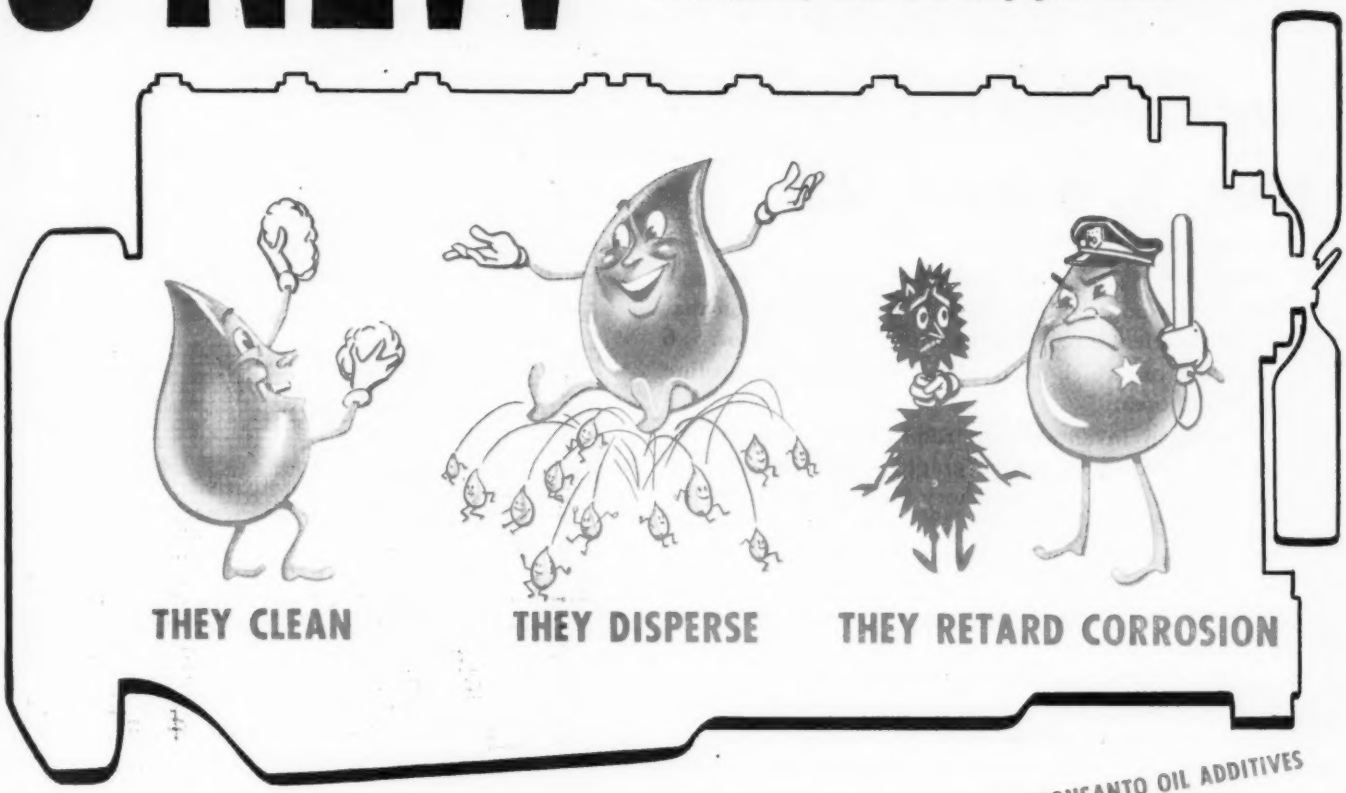

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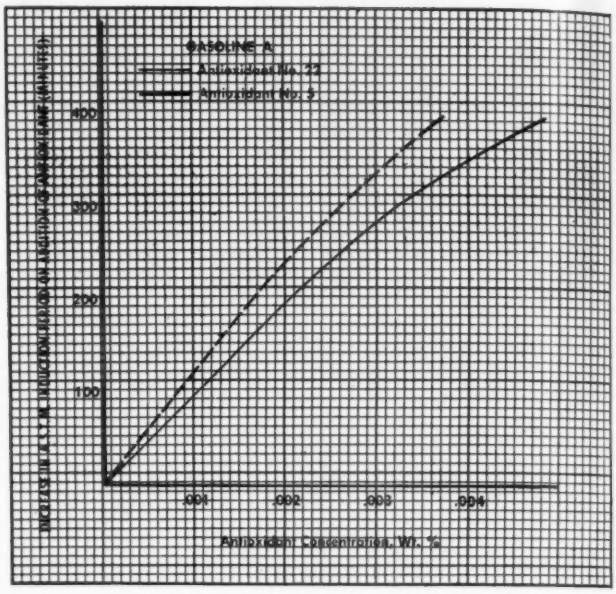

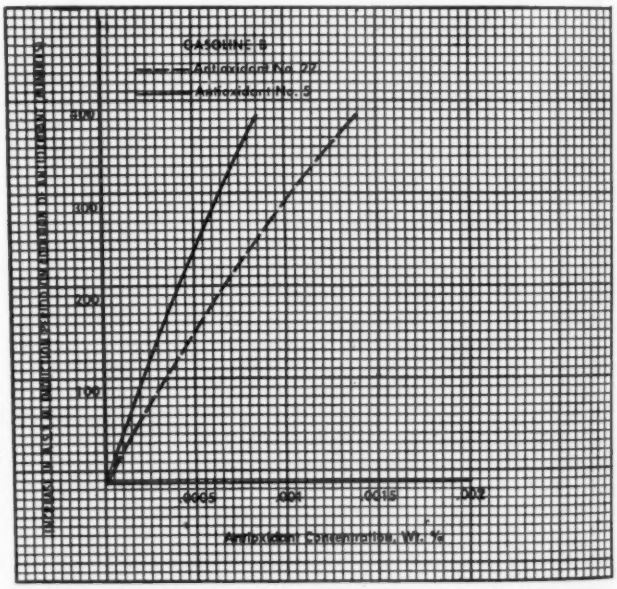

Note: The antioxidant concentration in these graphs is expressed as active ingredient for purpose of direct comparison.

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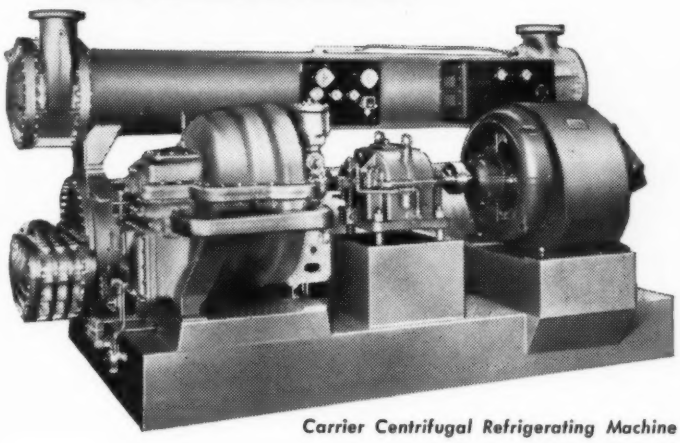

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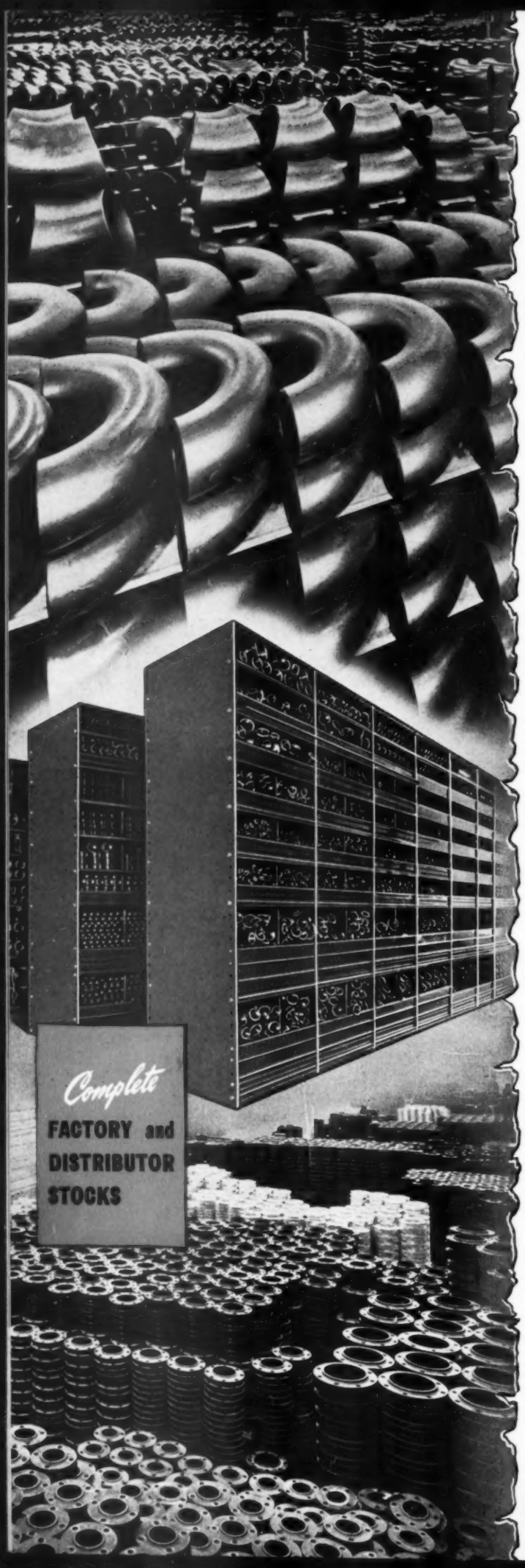

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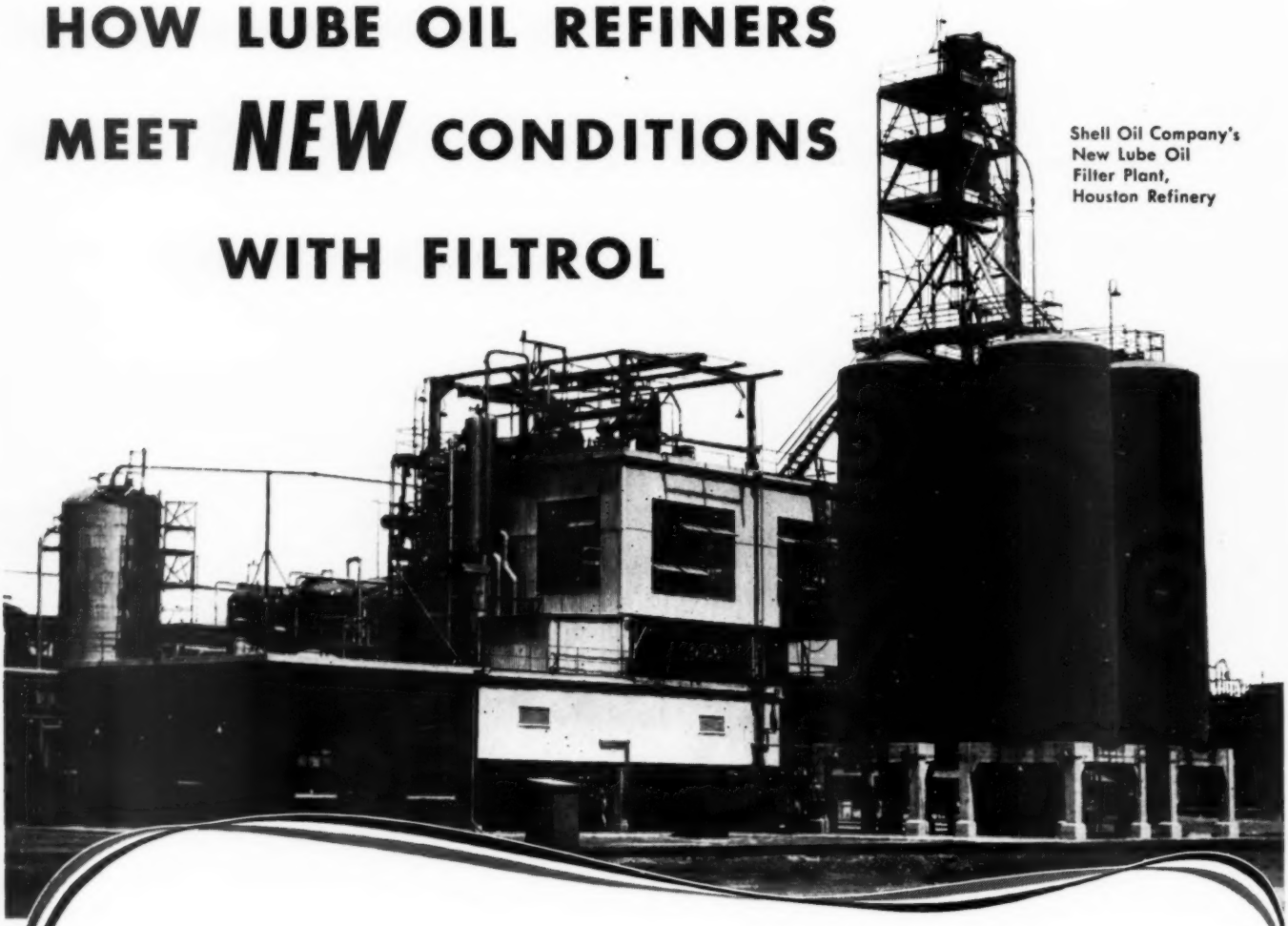

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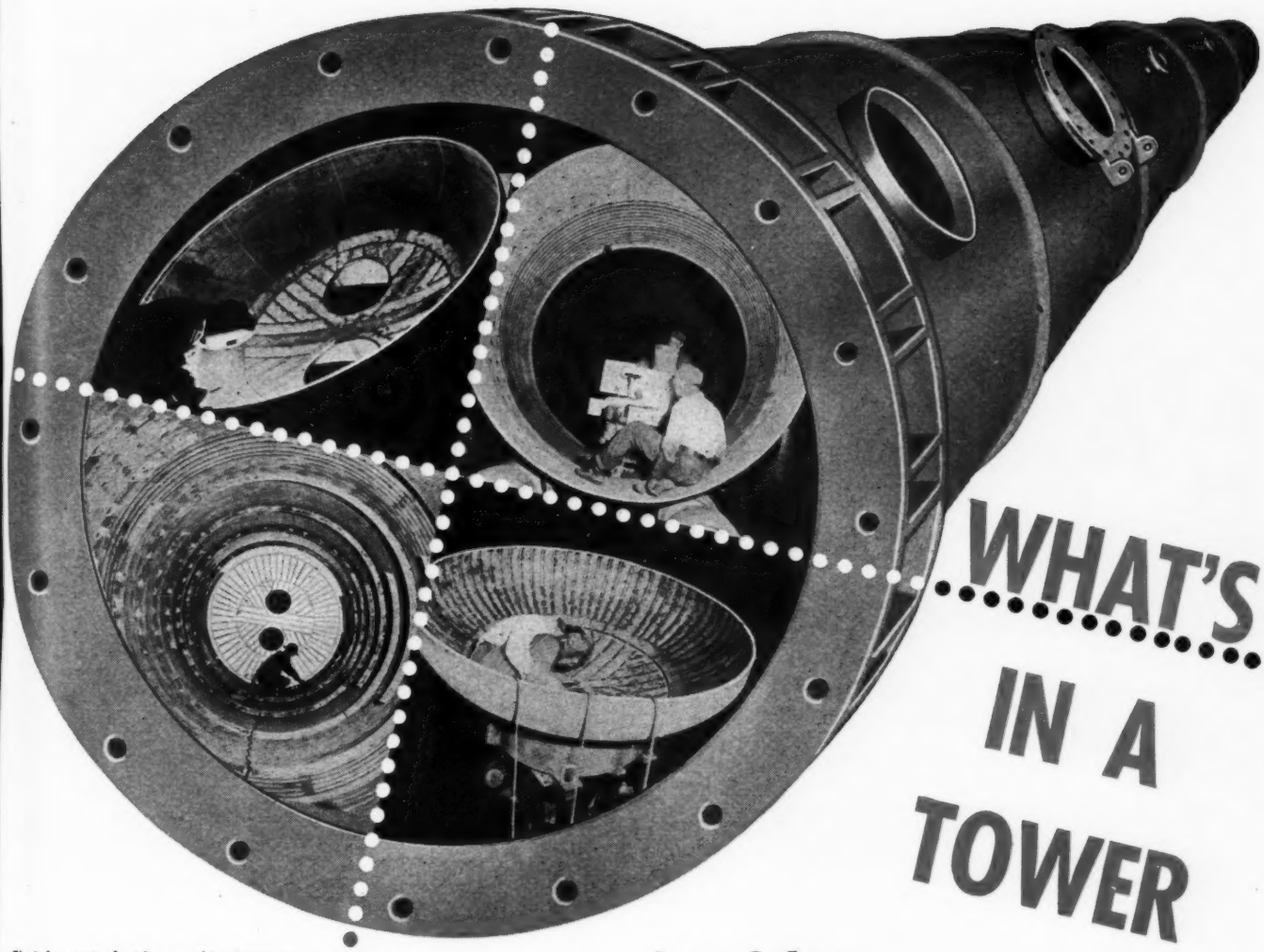

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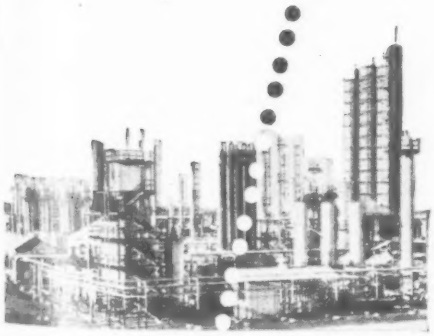

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To rely on Crane for all piping is to gain maximum benefit from standardization practices. As the world's most complete **Single Source of Supply,** Crane simplifies every step of piping procedures, from design to erection to maintenance.

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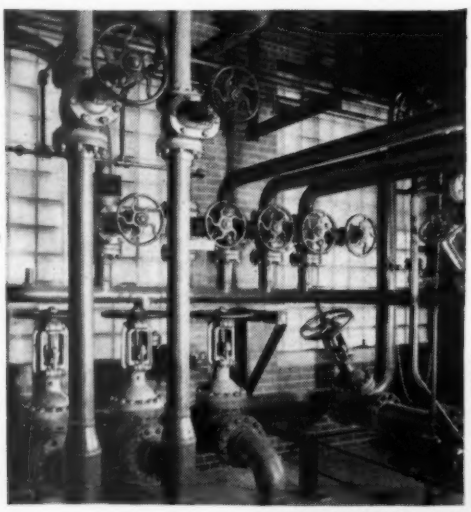
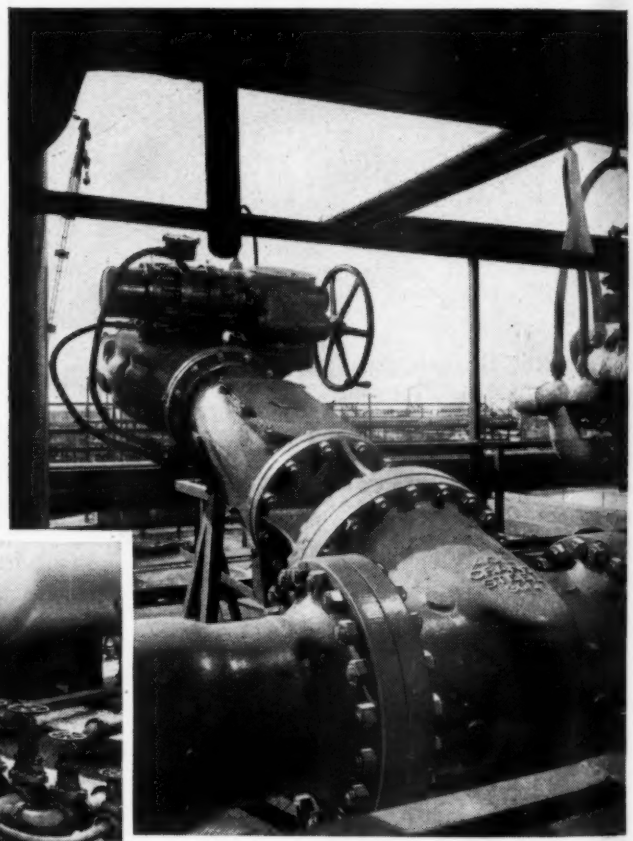


Crane 4 and 6-inch 300-pound cast steel gate valves on lines to pump-out pump in pump room of vapor recovery unit.



Crane 14-inch, 300-pound, motor-operated gate valve on gas line atop compressor house at catalytic cracking unit.

Lines on manifold and mixing coils in continuous sweetening plant equipped with Crane iron body gate valves and flanged fittings.

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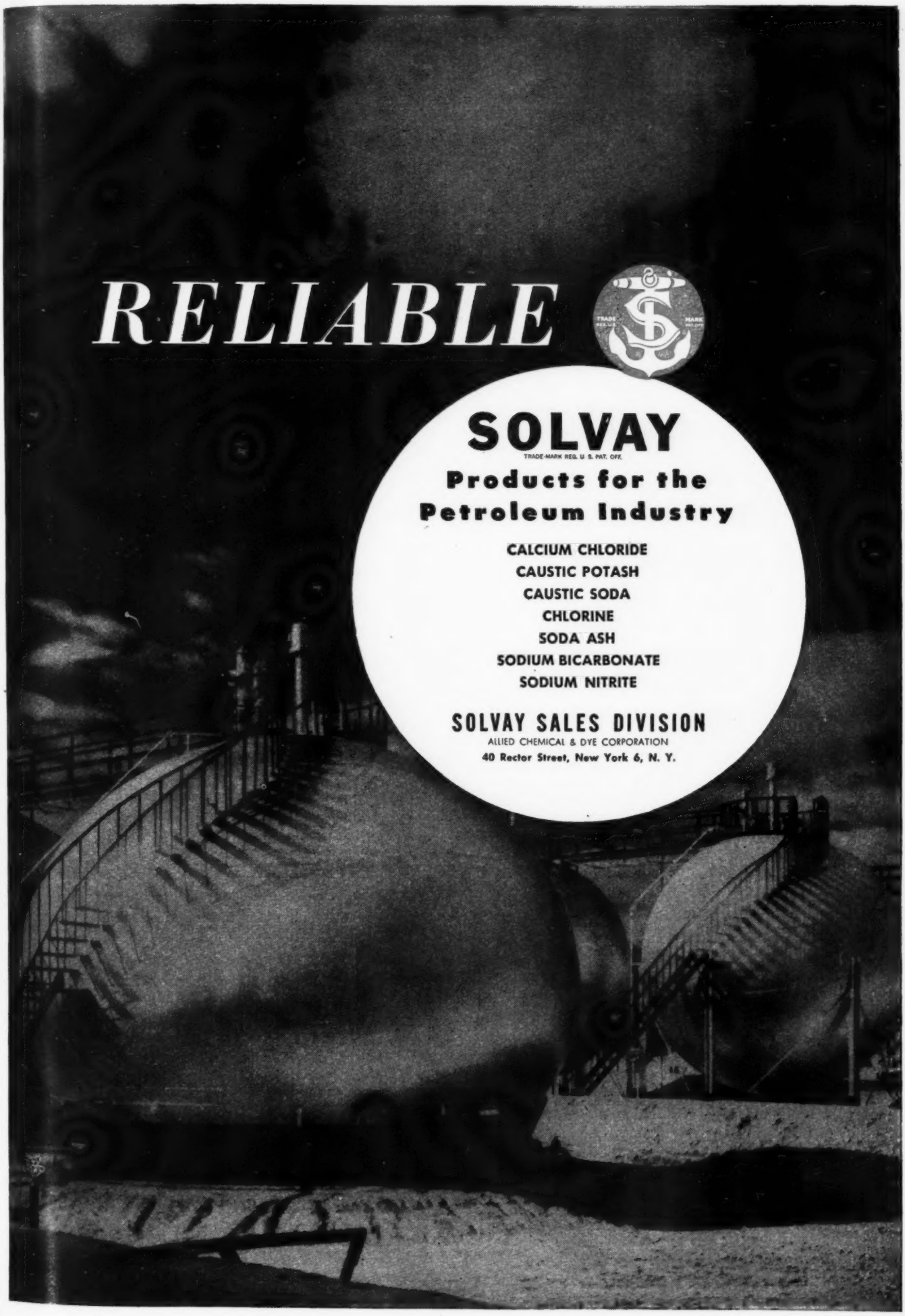
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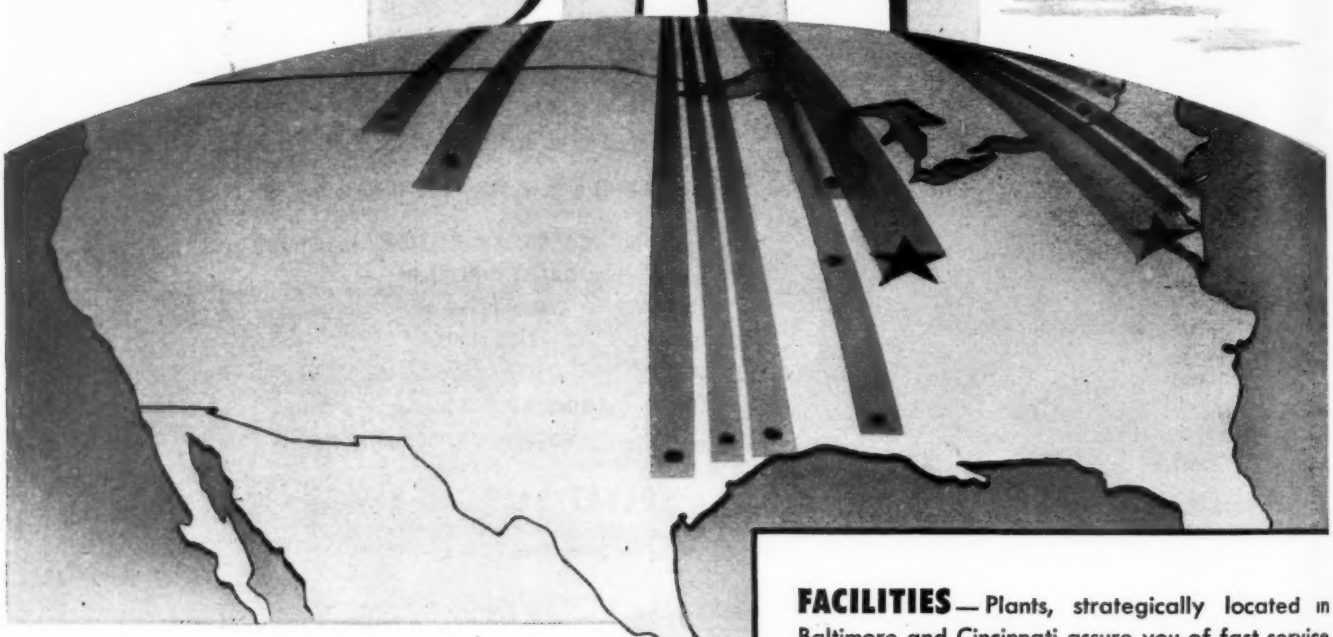

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It is available in sizes from ⅛" to 1" inside diameter, with choice of 5, 7, 9, and 11 fins to the inch.

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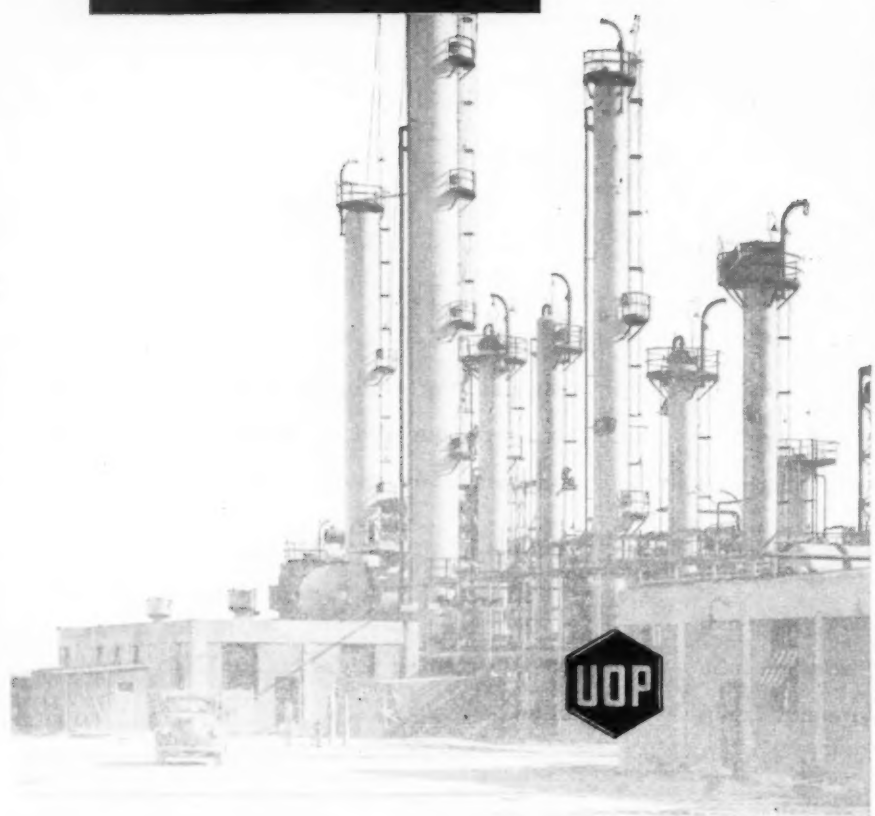

Wilshire Installs Gas Recovery System

By M. A. Machris
Vice Pres., Wilshire Oil Company

THROUGH the installation of an improved gas recovery system as an adjunct to the UOP thermal cracking plant in our Norwalk, Calif., refinery, Wilshire has placed itself in a position to take advantage of the favorable market for LPG which presently exists in our territory.

M. A. Machris

The job was done at remarkably low cost because a considerable amount of equipment in the aviation gasoline section of the refinery, now shut down, was available.

Construction by Refinery Force

The engineers of Universal Oil Products Company worked closely with us in designing and engineering the project while the construction was done by our own forces.

To visualize the new facilities, it is necessary to describe briefly the cracking section of the refinery as it existed before the new work was undertaken.

Cracking Unit Rated 8,000 B/D

The cracking unit is of the two-coil, full flashing type, consisting of heavy and light oil heaters, a reaction chamber, a flash chamber, a main fractionating tower, a secondary column, a low pressure absorber and a stabilizer. Rated capacity was 8,000 b/d. We also have a thermal reforming unit, rated capacity 4,000 b/d, which had been shut down since the war.

As operated before revamping, the overhead from the cracking plant fractionator was split into two streams by means of a secondary fractionator. The heavy gasoline went directly to an acid treating operation, thereby precluding its use as absorbing medium in the gas recovery system. The light stream was accumulated in a receiver and from there charged to a stabilizer. The overhead from the stabilizer was delivered to polymerization after the gas was processed in a TPP unit for hydrogen sulfide removal.

The gas from the secondary tower receiver went to the low pressure absorber. The absorbing medium was a side cut from the main fractionator. The rich oil from the absorber was returned to the main column of the cracking plant and the absorber lean gas was discharged to fuel. This lean gas contained recoverable quantities of valuable P-P and B-B, all of which were burned as fuel.

The purpose of the revamping job was three-fold: 1. To increase recovery of propane and butane. 2. To obtain a salable propane fraction. 3. To remove hydrogen sulfide from the recovered gas by fractionation, thus eliminating the cost of operating the TPP unit. How

(Advertisement)

these have been accomplished is shown by the comparative analyses of the effluent gas streams before and after:

	Absorber Gas To Fuel		Poly Feed	
	Before Revamp	After Revamp	Before Revamp	After Revamp
H_2S	10.9	6.8	1.7	.2
H_2		5.2		
C_1	33.1	43.0	1.4	—
C_2	23.2	32.9	10.4	1.0
$= C_3$	9.4	6.1	14.2	16.2
C_3	13.0	5.4	22.8	25.1
$= C_4$	4.3	.1	22.7	29.6
C_4	3.8	.3	20.4	26.9
C_5	2.3	.2	6.4	1.0

Used Aviation Gas Equipment

Equipment used in the production of aviation gasoline and unused since the war furnished most of the equipment for the new facilities. Six vessels were available and five were in the immediate area. These were the reformer stabilizer, a straight run gasoline stabilizer, a natural gasoline stabilizer, a low pressure rerun column, the thermal cracker stabilizer and the thermal cracker absorber.

The low pressure rerun column was installed as a primary absorber using partially depentanized light gasoline as the absorbing medium. The old absorber was retained as a secondary absorber using a light side cut from the main column on the cracker as the absorbing medium.

The existing cracker stabilizer was converted to use as a partial depentanizer. Part of the bottoms from this column goes to the primary absorber, the remainder to storage by way of a caustic scrubber. Two streams, one liquid and one gas, are taken overhead. These streams contain the recovered B-B and P-P. The liquid stream goes to the stripping section of a high pressure de-ethanizer, which was formerly the straight-run gasoline stabilizer.

The gas portion is charged to the high pressure absorption section of the de-ethanizer, the absorber being converted from the natural gasoline stabilizer.

The bottoms from the stripper section containg B-B, P-P and pentanes are charged to the poly feed column, formerly the reformer stabilizer. This column in LPG manufacture, operates as a depropanizer.

Designed for Flexibility

The gas plant is designed for maximum flexibility. Thus substantially H_2S free C_3-C_4 fraction can be taken overhead in the poly feed column as charge to polymerization or the column can be operated to produce an overhead cut that is substantially propane and meeting LPG specifications. The bottoms from the column may be blended directly with refinery light gasoline or debutanized for B-B make.

While not a part of the project, Wilshire is now preparing to put back into use the hydrogen sulfide removal unit as part of an operation to rid Wilshire fuel gas of its hydrogen sulfide content. It is being undertaken in cooperation with other Southern California refiners in order to rid Los Angeles skies of smog.

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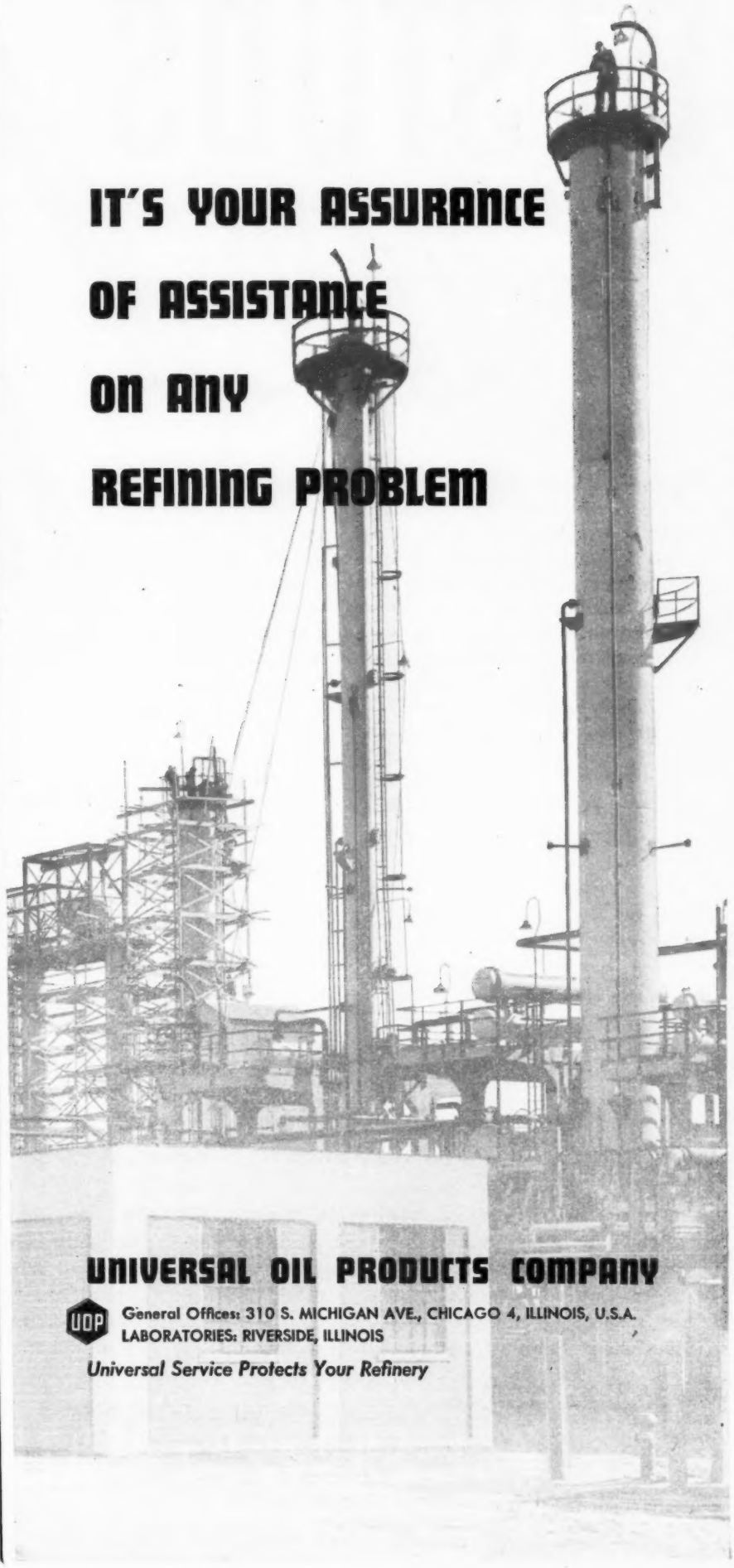

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Refinery engineers can count on two things when they order B7 studs from Bethlehem: (1) Getting the sizes they need, and (2) Good delivery. This is because Bethlehem stocks B7 studs in all diameters and lengths used by oil refineries. As for the steel from which these studs are made, B7 has what it takes for dependable service at medium-high temperatures and pressures. A chromium-molybdenum steel (AISI 4140, 4142 or 4145), B7 conforms to the requirements of ASTM Specification A193-48T. It fulfills the following chemical and tensile requirements:

B7 – CHEMICAL REQUIREMENTS

	Range	Check Variation, Over or Under
Carbon, pct	0.38 to 0.48*	0.02
Manganese, pct	0.75 to 1.00	0.04
Phosphorus, max, pct	0.04	0.005 over
Sulphur, max, pct	0.04	0.005 over
Silicon, pct	0.20 to 0.35	0.02
Chromium, pct	0.80 to 1.10	0.05
Molybdenum, pct	0.15 to 0.25	0.02

**For sizes over 3½ in., and up to 4 in., inclusive, the carbon content may be 0.50 pct, max.*

B7 – TENSILE REQUIREMENTS

	Minimum Tempering Temperature F	Tensile Strength min., psi	Yield Point min., psi	Elongation in 2 in., min., pct	Reduction of area min., pct
Diameters 2½ in. and under	1000	135,000	115,000	15	50
	****1100**	**125,000**	**105,000**	**16**	**50**
	1200	105,000	90,000	17	55
Diameters over 2½ in., and up to 4 in., inclusive	1000	125,000	105,000	15	50
	1100	115,000	95,000	16	50
	1200	105,000	85,000	17	50
Diameters over 4 in., and up to 7 in., inclusive	1000	110,000	85,000	16	45
	1100	100,000	75,000	18	50
	1200	90,000	65,000	20	50

***Properties in bold-face type represent standard heat-treatment to be given material as stocked for use under the specification as agreed by manufacturers.*

B7 is one of seven grades of steel being produced by Bethlehem for high-temperature, high-pressure fastenings. The others are: B7a, B14, BA, BB, BC, and A261 —an all-inclusive range designed to meet virtually every need.

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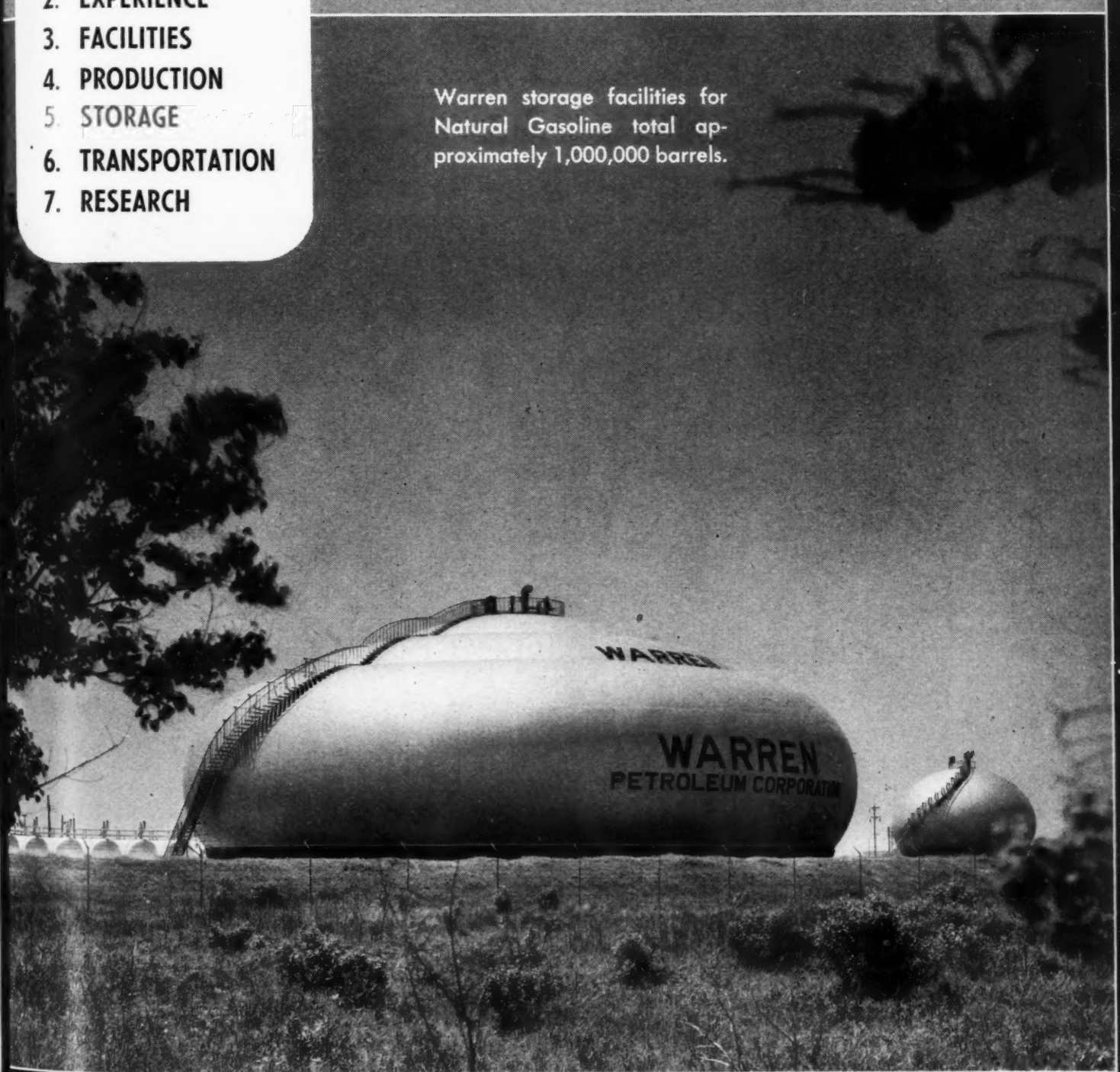

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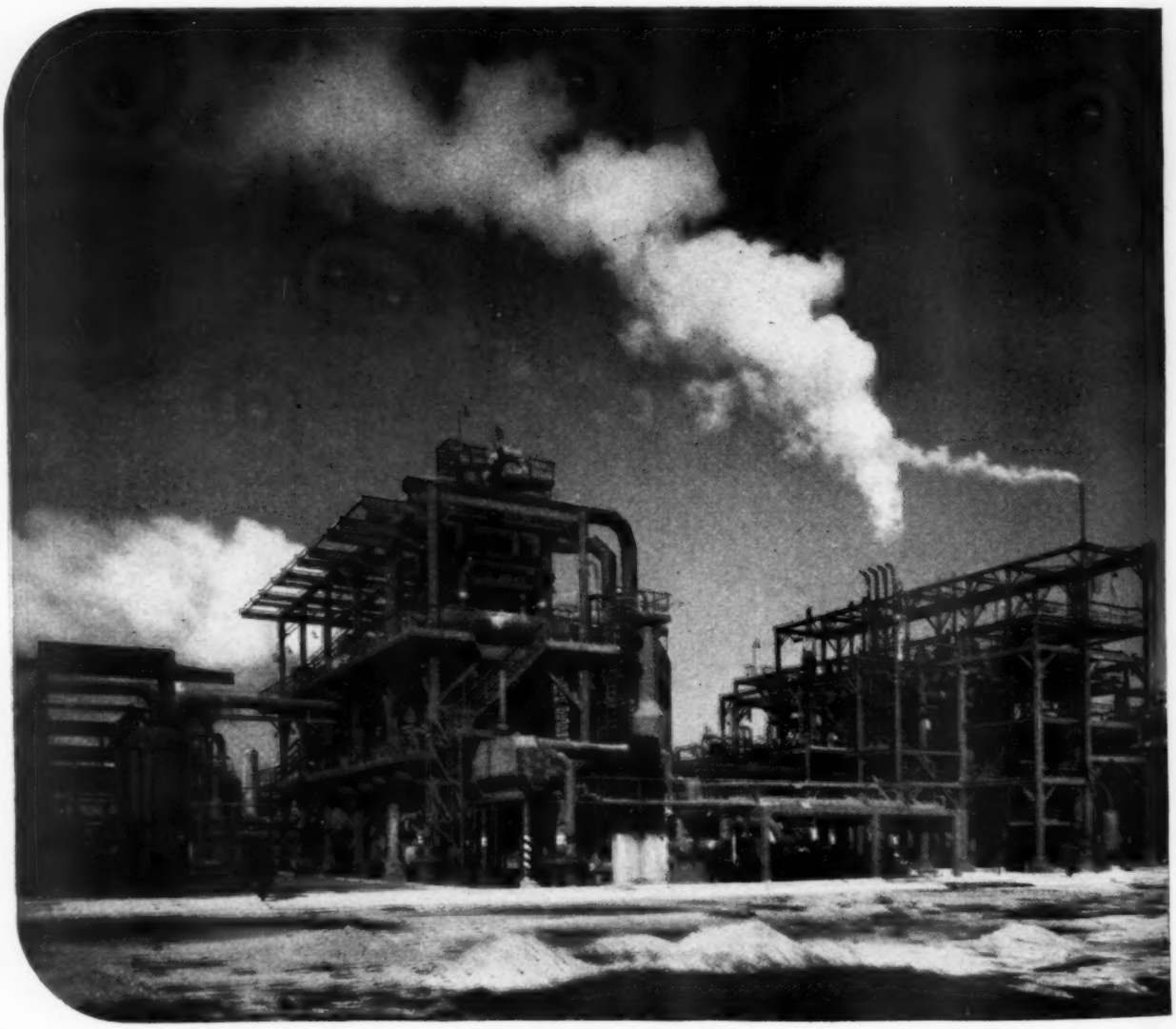

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Badger often works as a supplemental organization to the client's permanent engineering staff

Many large companies having permanent engineering and technical staffs of their own for long range planning and current operations employ Badger for immediate major expansion projects. Because we work for many clients as their supplementary engineering department, we maintain an organization fully equipped to absorb your overload. This relieves management of the responsibilities often arising from sudden increases in engineering, procurement and construction loads and further permits the client's key technical personnel to work in close cooperation with us as the project may require.

Badger's ability to work as a supplemental organization, backed by broad experience in the petroleum, chemical and petro-chemical fields, insures overall execution in accordance with the client's concepts without the necessity for burdensome attention to details.

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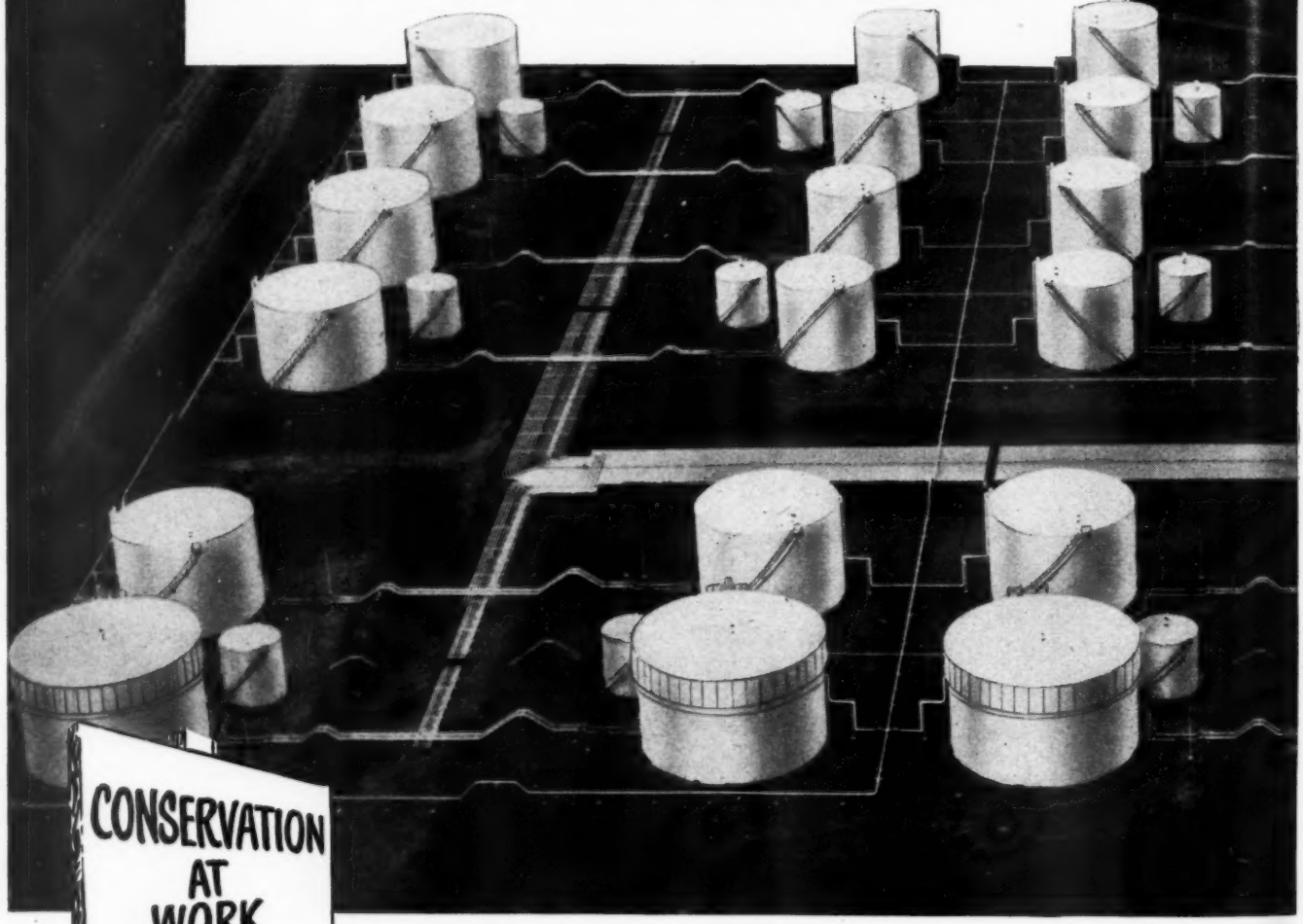

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Graver Expansion Roofs effectively prevent all breathing or standing losses; and when vapor volumes are balanced during filling and emptying operations, they also eliminate filling losses. In addition, Graver Expansion Roofs offer the advantages of simplicity of design, ease and accuracy of gauging, low maintenance costs, and perfect roof drainage.

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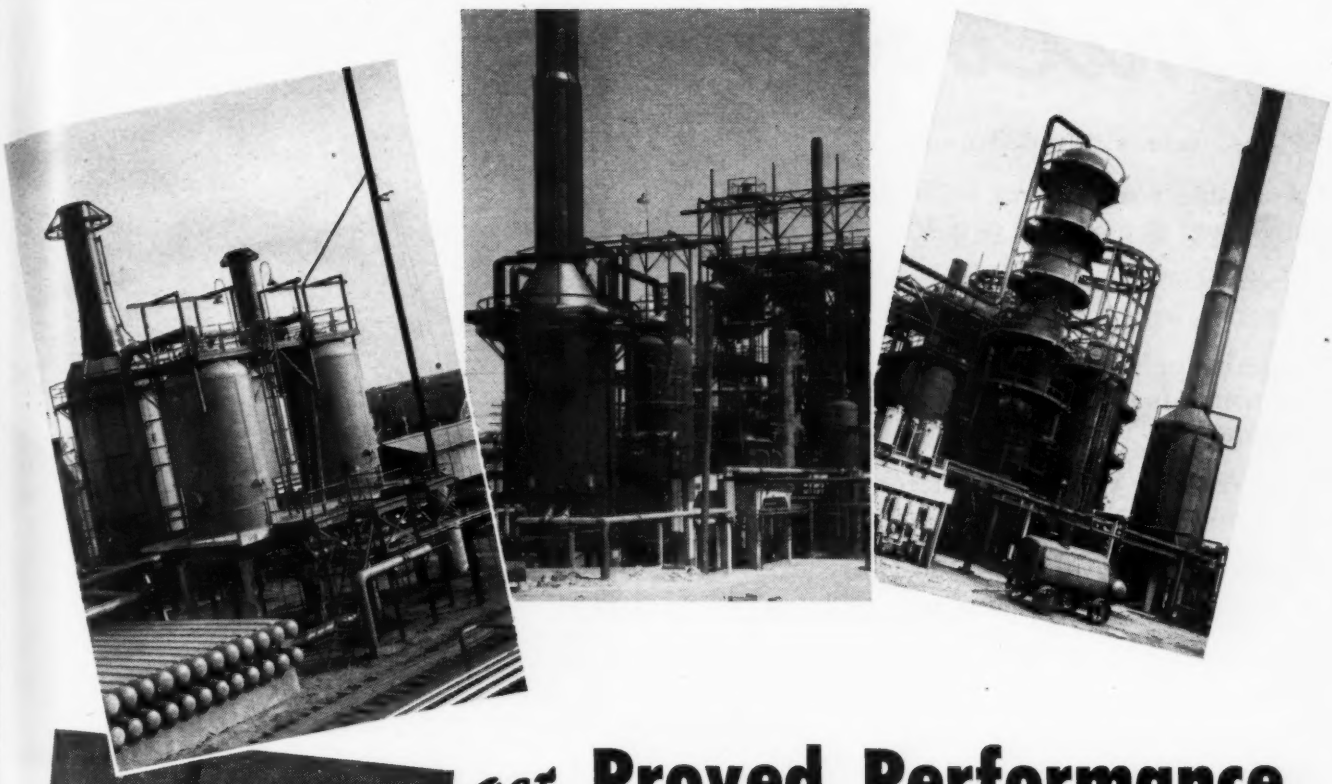

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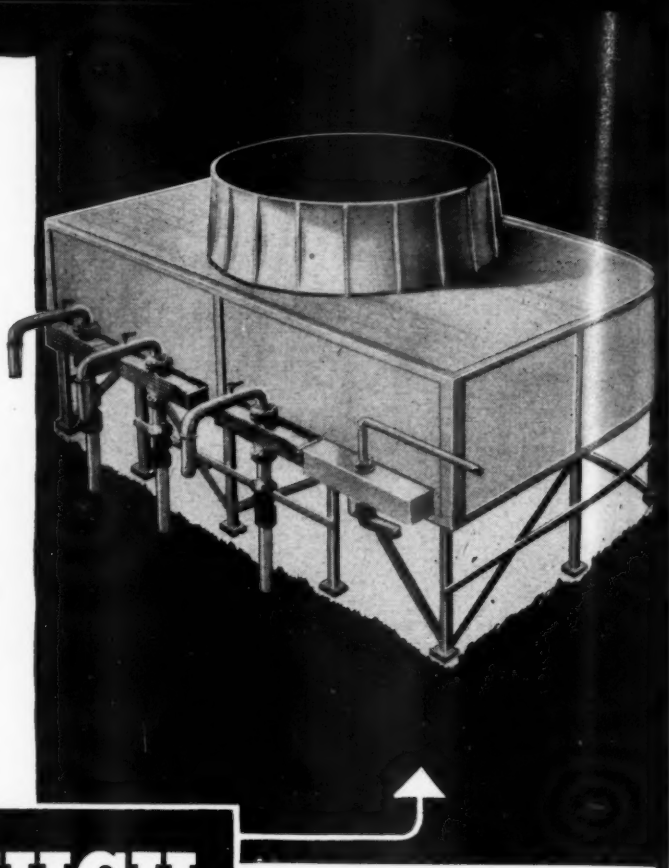

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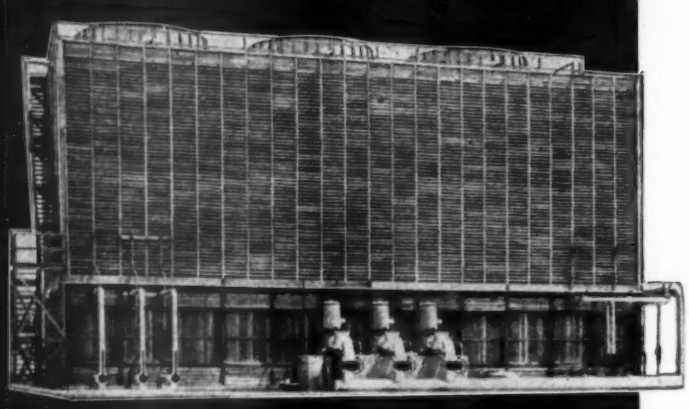

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- » Famous cooling tower trade names such as Aquatower, Double-Flow, Verflow.
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- » Ask for Bulletin G-48.

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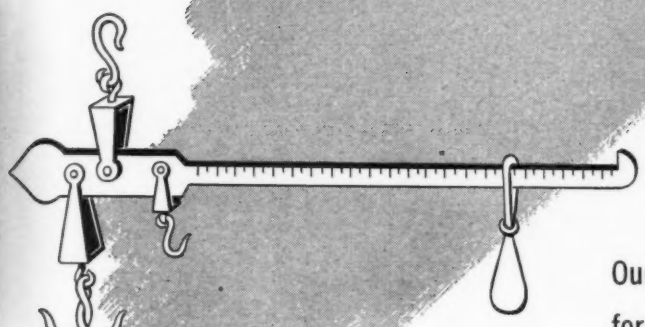

Ours would weigh nearly four billion pounds, for that's how much Attapulgus Fullers Earth and Porocel Activated Bauxite we've shipped to petroleum refiners.

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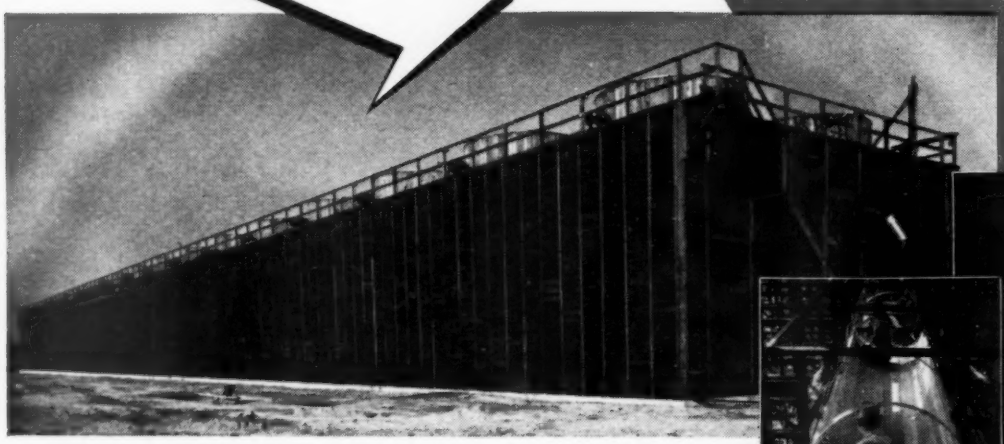
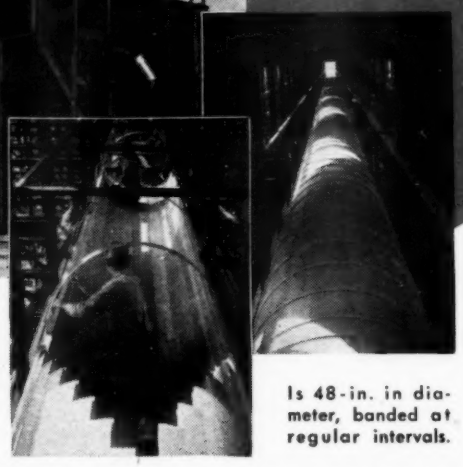


Redwood Main Distribution Header at top of Cooling Tower is over 400 ft. long.



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Is 48-in. in diameter, banded at regular intervals.

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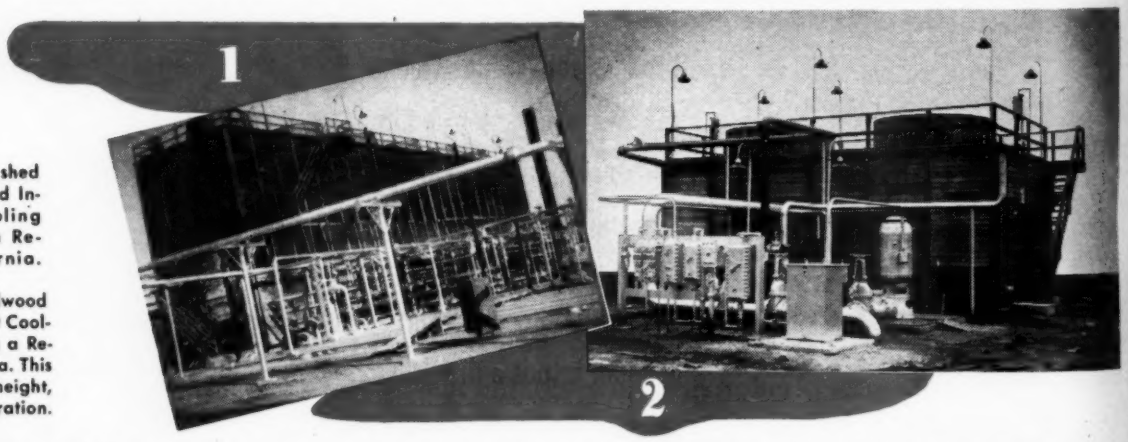

1. Six-Cell, coil shed type, Redwood Induced Draft Cooling Tower serving a Refinery in California.

2. Two-Cell, Redwood Induced Draft Cooling Tower serving a Refinery in Oklahoma. This Tower is low in height, economical in operation.

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WCEC Cooling Towers today are being designed and built to handle any specified service demanded by any specific industry. In the Petroleum field, for instance, WCEC has designed and engineered a Cooling Tower meeting the specialized needs of the World's Largest Lube Plant. What we have done for them, we can do for you.

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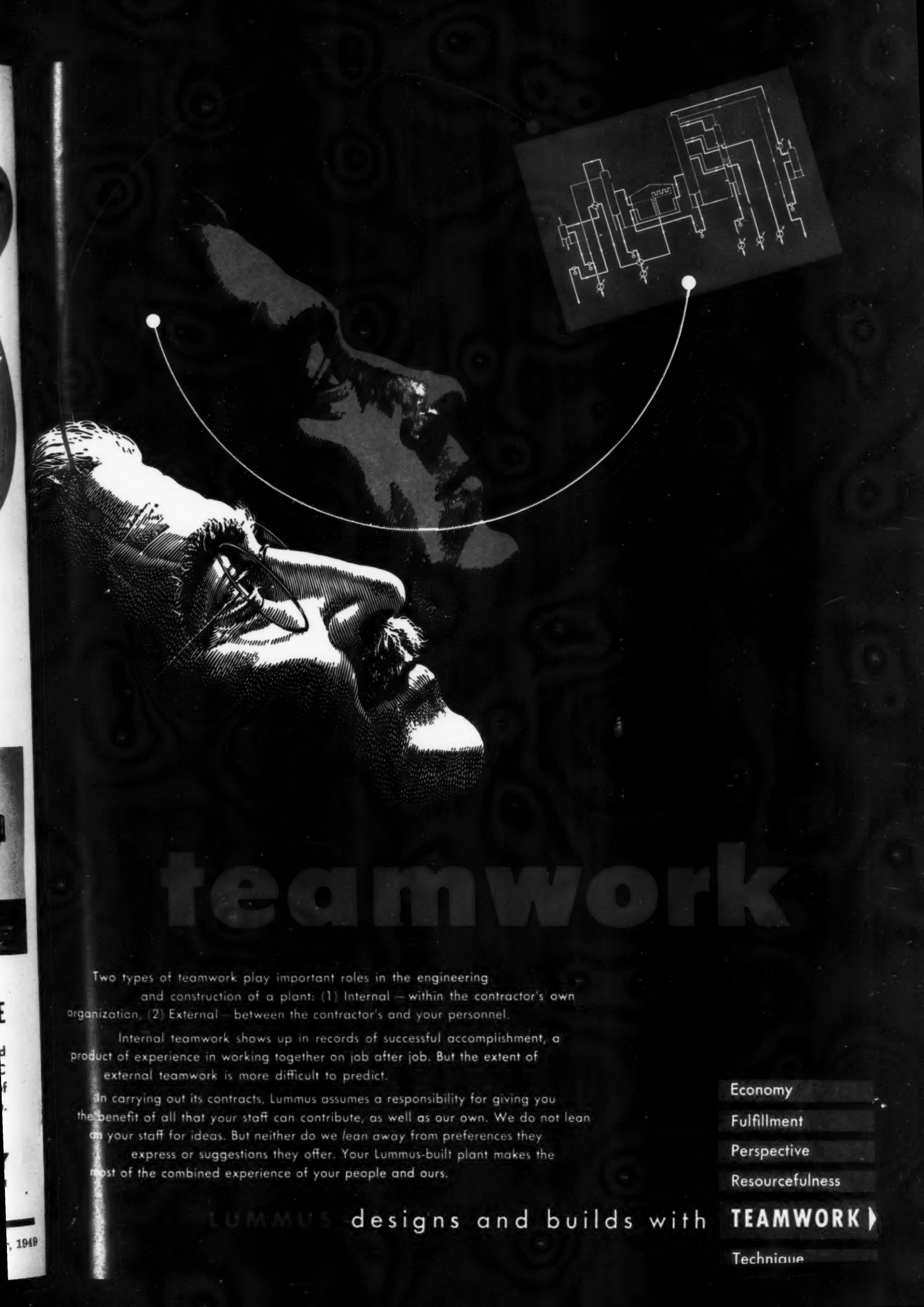

teamwork

Two types of teamwork play important roles in the engineering and construction of a plant: (1) Internal — within the contractor's own organization, (2) External — between the contractor's and your personnel.

Internal teamwork shows up in records of successful accomplishment, a product of experience in working together on job after job. But the extent of external teamwork is more difficult to predict.

In carrying out its contracts, Lummus assumes a responsibility for giving you the benefit of all that your staff can contribute, as well as our own. We do not lean on your staff for ideas. But neither do we *lean away* from preferences they express or suggestions they offer. Your Lummus-built plant makes the most of the combined experience of your people and ours.

LUMMUS designs and builds with **TEAMWORK**

Economy
Fulfillment
Perspective
Resourcefulness
Technique

teamwork in process development

In the development of improved methods of producing lubricating oil, Lummus has worked in close-knit cooperation with many leading oil companies. Lummus' exclusive pilot plant equipment for lube-oil process development has been employed to explore process alternatives suggested by these customers, supplementing their own research. More than 85 process units for solvent refining and dewaxing have resulted from this work — including the largest lube-oil plant in the world.

teamwork in plant design

Lummus coordinated its engineering with the requirements and preferences of a leading chemical company — and laid the groundwork for an advanced type of ethylene plant. High yields are being obtained from a wide range of charge stocks. Operating costs are favorable, too.

teamwork in plant construction

Construction in foreign countries and remote locations calls for a close relationship at the site between Lummus' personnel and oil company field forces. Assignment of men with a thorough knowledge of the region, its customs, laws and labor regulations, helps maintain this local cooperation. Records are maintained in accordance with client requirements for progress reports and cost control.

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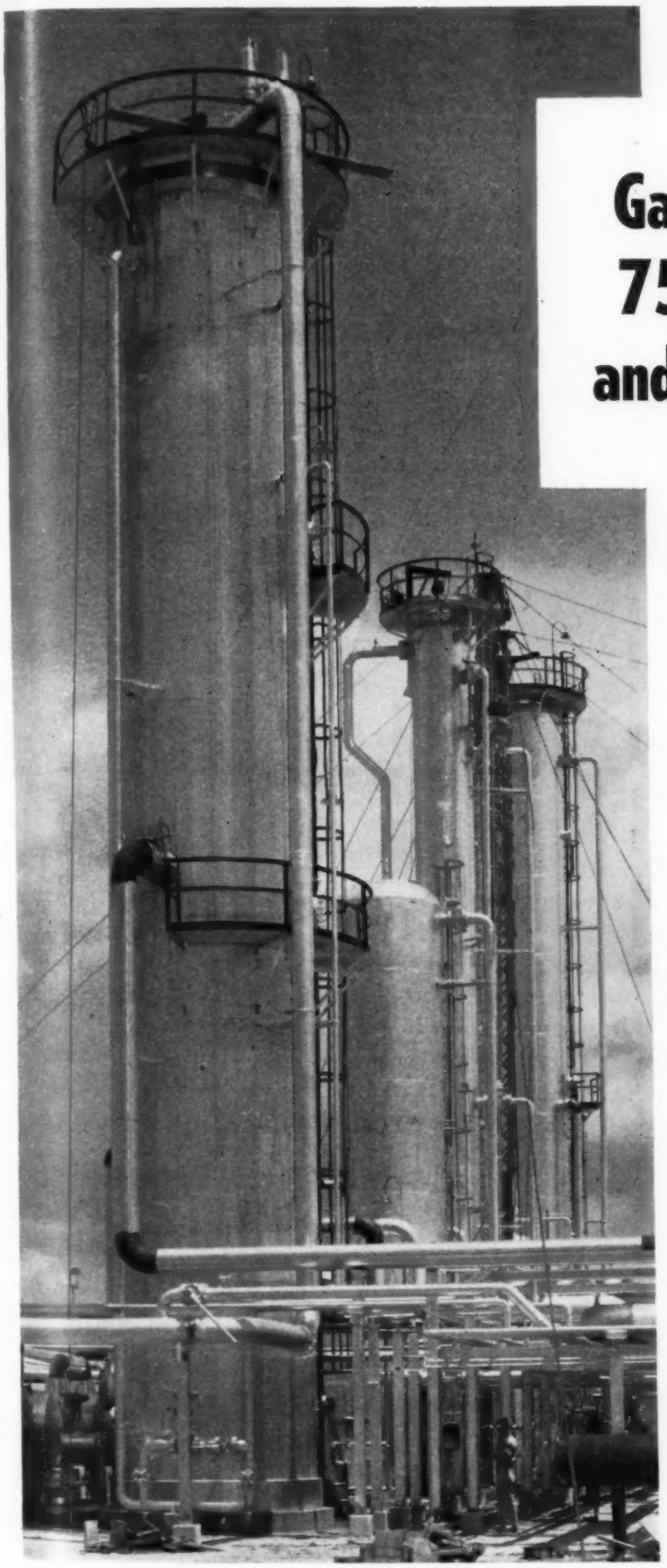

Gasoline Plant Recovers 75 per cent of propane and 98 per cent of butane

These truly outstanding recovery rates are being achieved at the Sid Richardson Company's Kermit, Texas, plant. In order to obtain such phenomenal results, this company selected the *right* equipment and then added two refinements, namely, recirculation of lean oil to the absorbers and extensive propane refrigeration.

We furnished the following equipment for this highly efficient plant: the 10-ft. diam. by 69-ft., 6-in. high still shown at the left in the accompanying view; a 7-ft. diam. by 95-ft., 1-in. high debutanizer tower; two 4-ft. diam. by 10-ft. accumulator and scrubber drums; three 3,000-bbl. Hortonspheres; and three 5,000-bbl. Hortonspheroids.

This plant is typical of many where we have furnished steel plate structures to meet a variety of operating conditions. The services we offer the petroleum processing industry include x-raying and stress relieving to meet code requirements, furnishing corrosion-resistant alloy linings, and building refinery equipment for a special pressure, vacuum, or temperature condition. The next time you expand or revamp existing facilities let us furnish quotations or equipment that means efficient operation. Write our nearest office for details.

HORTON PRODUCTS FOR THE PETROLEUM INDUSTRY

- HORTON FLOATING ROOFS — Available in three designs . . . Double-Deck, Pontoon, or Pan type to provide evaporation protection for a wide range of volatile hydrocarbons.
- HORTONSPHERES—For storing butanes, propanes and products of similar volatility.
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New York 6 .....3310-165 Broadway Building
Philadelphia 3 ..1630-1700 Walnut St. Building
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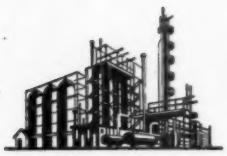
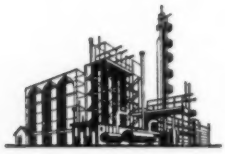
REFINERS RELY ON McKEE...



FOR SOUND DESIGN

Hundreds of successfully operating McKee-designed refineries all over the world prove the value of McKee design.



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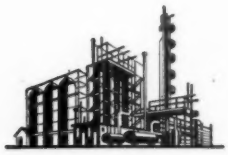
McKee's long experience and closely coordinated organization of well-qualified specialists assure the refiner efficient, economical engineering and procurement.



FOR PROMPT, ECONOMICAL CONSTRUCTION

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ARTHUR G. McKEE & COMPANY

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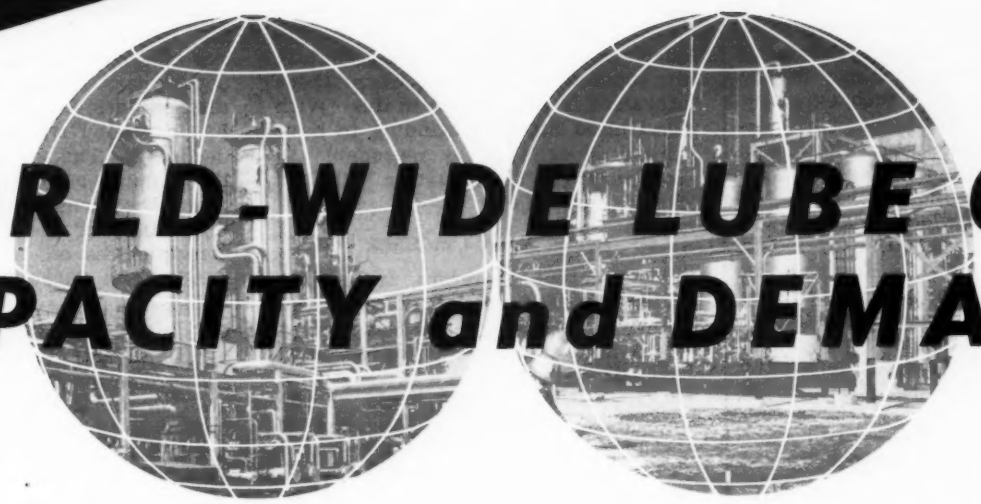


WORLD-WIDE LUBE OIL CAPACITY and DEMAND

By PAUL V. KEYSER, Jr.
Manager, Lubricating Oil Dept., Socony-Vacuum Oil Co.

World capacity to produce lubricating oils is being expanded at such a rate that it will exceed world demand for many years to come. Increases in foreign capacity are just about keeping pace with increases in foreign demand, indicating that for some years the U.S. will continue to be the country with the greatest surplus of capacity over demand. Lubricating oil production facilities in the U.S., therefore, will operate considerably below capacity, with curtailments being made in the conventional type operations rather than the solvent refining plants.

The following paper by Mr. Keyser was presented at the recent meeting of the National Petroleum Assn. in Atlantic City, N. J., Sept. 14-16, and is presented here essentially in its entirety.

HISTORICALLY, the United States has been by far the largest supplier of the world's lubricants. In the immediate prewar years it supplied approximately 75% of the world's demand. The destruction of foreign facilities during the war and the rush to replenish world inventories in the immediate postwar years caused, in 1946 through 1948, a disproportionate demand for lubricating products from the United States. In the year 1948, 87% of the world's requirements was supplied from the United States.

During those immediate postwar years, the spot shortages and dislocations of supply for particular grades were rather pronounced. This situation was foreseen by many of the suppliers, or potential suppliers, of lubricants as far back as the early days of the war. The need for new facilities was further appreciated when it was realized that a large proportion of the units, both in this country and abroad, were capable of producing only what we refer to as conventional oils generally regarded as of lower quality than those produced from the so-called solvent operations. Extensive programs were developed for the construction of new refining facilities. The resulting expansion will be virtually completed in the United States in early 1950 and in the balance of the world within the next two or three years.

It is the intent of this paper to present a picture of world lubricating oil production capacity and to compare this with anticipated demand, using the year 1948 as a base and projecting both capacity and demand to the years 1950 and 1953. All the figures in the various tabulations and in the text are on the basis of 42-gallon (U. S.) barrels per day.

The figures shown for 1948 capacity are the production figures for that year. Capacity estimates for 1950 and 1953 are formed by adding to the 1948 figures the estimated finished oil capacities of new facilities that will have been completed before the end of those years. By this method, figures do not comprehend capacity which,

(1) May have been available but was not in use during 1948, which would tend to understate the results,

(2) Conventional capacity to be retired on completion of new solvent facilities, the inclusion of which would tend to overstate the results.

The demand figures for 1948 are actual figures representing oil consumed. The estimates of demand for 1950 and 1953 have been built up from a variety of sources including estimates of motor vehicle registration in the United States, industrial activity in the United States, and a survey within each individual foreign country by our own Foreign Trade Department and others. Obviously, these estimates assume reasonably stable world conditions without major disruptions beyond our ability to forecast.

Table 1 shows the productive capacity within the United States, the internal United States demand, and the product available for export, actual for the year 1948, and projected on the basis outlined for the years 1950 and 1953. It is readily apparent that the expansion of our capacity will result in a substantial increase in the amount of lubricating oil available for export from the United States in the years 1950 and 1953.

Table 2 shows the estimates of

foreign productive capacity and demand and, by difference, the demand on the United States from foreign sources for the three years under consideration. It appears that increases in foreign capacity will only about keep pace with increases in foreign demand leaving a nearly constant requirement against the U. S. in face of a large increase in the quantity available for such export.

Table 3 summarizes the world capacity, world demand, and the excess of capacity over demand for the same years. It will be noted that in the year 1950, worldwide capacity will exceed demand by 52,000 b/d, and in 1953 by 43,000 b/d. However, in each of those years, although the United States will have a substantial oversupply, the balance of the world will continue to have a deficit of supply versus its own internal demand.

All New Plants Are Solvent Type

At this point it is perhaps desirable to make a few comments on quality and price and their relationship to demand on U. S. versus foreign sources. Table 4, which gives supply and demand figures for all countries, differentiates between solvent extraction capacity and conventional capacity. It has now been recognized that lubricating oils produced in solvent extraction units are generally superior in quality for most applications to those produced from the same crude by conventional methods.

It should be noted that all of the new capacity projected for 1950 and 1953, both in this country and abroad, is of the solvent type. It will further be seen that the ratio of solvent to total capacity in the United States will be at least 59% in 1953, whereas in the balance of the world it will be 50%. This factor, plus the advantages of greater technical knowledge and experience, will mean that the United States will continue to have some edge with respect to quality.

Price levels for the various grades in the United States are presently depressed, being generally down to or below the prewar prices. On the other hand, recent experience indicates that prices for products produced in foreign countries are slightly to substantially higher than those prevalent in the United States. With the United States continuing to have excess capacity, it is reasonable to assume that this situation will not change appreciably.

U. S. Must Cut Back

Were it not, therefore, for certain political and financial factors, well known to those doing business in world markets, it could be assumed that our industry is in a healthy competitive situation. The fact of the matter is, however, that because of the desire of the nations of the world for self-sufficiency, and because of currency restrictions, even uneconomic capacity in foreign countries continues to operate at the expense of our own productive facilities. All the conclusions in this paper are based on the assumption that this situation will not drastically change. It is therefore apparent that, in spite of quality and in spite of price, the excess of capacity over demand will be brought into balance by the cutting back of refining largely within the United States.

Foreign Capacity May Expand

There is another factor which is worthy of consideration. The foreign productive capacity is based upon units which are virtually assured of being built. It is reasonable to assume that, since it is estimated that there will be a large deficit of foreign refining capacity, there may be additional expansion of facilities outside the United States not included in these forecasts. This of course will simply further exaggerate the depressing effect upon operations in the United States.

Questions may arise as to the validity of the estimated internal U. S. demand estimates for 1950 and 1953. Our experience in the past 18 months has indicated that, although more passenger cars, trucks and other vehicles are operating, the consumption of lubricants by transportation units is declining. This is undoubtedly due to a number of factors, most important of which are the increasing proportion of new vehicles, which consume less oil, and the improving quality and durability of products.

The consumption of lubricants in the industrial field is based upon industrial activity and it is the general prediction of economists that the level of U. S. industrial activity in 1950 will be from 5% to 10% below that of 1948, and even in 1953 will probably not greatly exceed that of 1948. On the basis of these economic forecasts, and the apparent declining ratio of lubricating oil to gasoline in the automotive field, we cannot arrive at any conclusion but that demand in the United States will be as predicted.

Foreign Demand on the Up

On the other hand, it is generally recognized that both transportation and industrial activity in foreign countries have not yet fully recovered and should continue to improve throughout the next few years. Actual foreign demands for 1950 and 1953 may deviate further from our estimates than will the internal demands of the United States. It is significant that, if foreign demand does not increase at the rate predicted, demand on the United States will decline further than has been forecast in Table 2.

It is not within the scope of this paper to deal with the complexities of international exchange. It must be recognized, however, that the availability of the various currencies within any given country may have an appreciable effect upon the demand realized from that country. It is interesting to note from a simple examination of the figures on demand versus the capacity of the respective countries that even in those countries which are generally construed to be sterling or soft currency, the internal capacity in 1953 will fall short of the internal demand within those countries by as much as 50%.

Conclusions

There are a number of important conclusions which can be drawn from the data and forecasts presented. There is no doubt whatever that world capacity will exceed world demand for many years to come. It is unfortunately obvious that the United

TABLE 1—United States Capacity and Demand

(42 gal. bbl. per day)

	Capacity	Demand	Available for Export
1948	141,000	98,000	37,000*
1950	178,000	94,000	84,000
1953	180,000	102,000	78,000

* Represents actual exports. In addition, 6,000 bbls. a day were added to inventories in the U. S. during 1948.

TABLE 2—Foreign Capacity and Demand*

(42 gal. bbl. per day)

	Capacity	Demand	Demand on U. S.
1948	28,000	65,000	37,000
1950	42,000	74,000	32,000
1953	52,000	87,000	35,000

* Except U.S.S.R. and Satellites.

TABLE 3—World Capacity and Demand*

(42 gal. bbl. per day)

	Capacity	Demand	Excess of Capacity over Demand
1948	169,000	163,000	6,000
1950	220,000	168,000	52,000
1953	232,000	189,000	43,000

* Except U.S.S.R. and Satellites.

TABLE 1—World Lubricating Oil Production Capacity and Demand for 1950 and 1953

(All figures expressed in terms of 42 gal. bbls. per day)

	1950					1953				
	Capacity					Capacity				
	Solvent	Conventional	Total	Internal Demand	Surplus or (Deficit)	Solvent	Conventional	Total	Internal Demand	Surplus or (Deficit)
WESTERN HEMISPHERE (except U. S.)										
Alaska	....	....	....	137	(137)	....	....	....	151	(151)
Argentina	....	1,700	1,700	2,814	(1,114)	....	1,700	1,700	3,515	(1,815)
Bolivia	....	....	....	58	(58)	....	....	....	68	(68)
Brazil	....	100	100	1,778	(1,678)	....	100	100	2,126	(2,026)
Canada-Newfoundland	2,800	2,400	5,200	6,000	(800)	2,800	2,400	5,200	6,531	(1,331)
Canal Zone-Panama	....	....	....	60	(60)	....	....	....	71	(71)
Central America	....	....	....	233	(233)	....	....	....	277	(277)
Chile	....	....	....	438	(438)	....	....	....	537	(537)
Colombia	200	....	200	332	(132)	200	....	200	362	(162)
Cuba	....	70	70	458	(388)	....	70	70	532	(462)
Ecuador	....	....	....	66	(66)	....	....	....	74	(74)
Guianas (Br.-Fr.-Surinam)	....	....	....	38	(38)	....	....	....	47	(47)
Jamaica	....	....	....	47	(47)	....	....	....	55	(55)
Mexico	....	1,000	1,000	2,364	(1,364)	....	1,000	1,000	2,841	(1,841)
Paraguay	....	....	....	14	(14)	....	....	....	16	(16)
Peru	....	300	300	378	(78)	....	400	400	562	(162)
Puerto Rico	....	....	....	164	(164)	....	....	....	200	(200)
Trinidad & Tobago	....	....	....	112	(112)	....	....	....	123	(123)
Uruguay	....	....	....	145	(145)	....	....	....	175	(175)
Venezuela & N.W.I.	4,900	2,600	7,500	682	6,818	4,900	2,600	7,500	959	6,541
West Indies (Other)	....	....	....	118	(118)	....	....	....	167	(167)
Total Western Hemisphere (except U. S.)	**7,900**	**8,170**	**16,070**	**16,436**	**(366)**	**7,900**	**8,270**	**16,170**	**19,389**	**(3,219)**
EASTERN HEMISPHERE (west of Suez)										
Marshall Plan Countries										
Austria	....	500	500	685	(185)	....	500	500	806	(306)
Belgium-Luxemburg	....	150	150	1,534	(1,384)	....	150	150	1,817	(1,667)
Denmark	....	....	....	715	(715)	....	....	....	781	(781)
Eire	....	....	....	414	(414)	....	....	....	460	(460)
France	600	4,400	5,000	5,644	(644)	3,000	4,400	7,400	6,576	824
Germany (Western)	1,000	3,800	4,800	4,918	(118)	2,300	4,300	6,600	6,603	(3)
Greece	....	....	....	405	(405)	....	....	....	521	(521)
Iceland	....	....	....	69	(69)	....	....	....	99	(99)
Italy (incl. Trieste)	800	400	1,200	2,301	(1,101)	1,100	600	1,700	2,493	(793)
Netherlands	....	2,000	2,000	1,260	740	....	2,000	2,000	1,329	671
Norway	....	....	....	647	(647)	....	....	....	740	(740)
Portugal & Islands	....	20	20	392	(372)	....	20	20	404	(384)
Sweden	550	250	800	1,353	(553)	550	250	800	1,575	(775)
Switzerland	....	....	....	575	(575)	....	....	....	592	(592)
Turkey	....	....	....	384	(384)	....	....	....	518	(518)
United Kingdom	4,450	3,600	8,050	15,000	(6,950)	8,250	3,600	11,850	16,582	(4,732)
Total Marshall Plan	**7,400**	**15,120**	**22,520**	**36,296**	**(13,776)**	**15,200**	**15,820**	**31,020**	**41,896**	**(10,876)**
Other Countries (west of Suez)										
Africa, West	....	....	....	548	(548)	....	....	....	685	(685)
Algeria	....	....	....	340	(340)	....	....	....	382	(382)
Canary Islands	....	....	....	33	(33)	400	....	400	36	364
Cyprus	....	....	....	30	(30)	....	....	....	33	(33)
Egypt	....	....	....	765	(765)	....	....	....	822	(822)
Finland	....	....	....	348	(348)	....	....	....	447	(447)
Gibraltar	....	....	....	8	(8)	....	....	....	8	(8)
Israel	....	....	....	175	(175)	....	....	....	200	(200)
Libya	....	....	....	71	(71)	....	....	....	88	(88)
Malta	....	....	....	19	(19)	....	....	....	19	(19)
Morocco, Fr.	....	....	....	304	(304)	....	....	....	356	(356)
Morocco, Sp.	....	....	....	30	(30)	....	....	....	36	(36)
Palestine-Transjordan	....	....	....	17	(17)	....	....	....	22	(22)
Spain	....	....	....	1,129	(1,129)	....	....	....	1,277	(1,277)
Sudan	....	....	....	49	(49)	....	....	....	49	(49)
Syria-Lebanon	....	....	....	167	(167)	....	....	....	197	(197)
Tunisia	....	....	....	159	(159)	....	....	....	170	(170)
Total Other Countries	....	....	....	**4,192**	**(4,192)**	**400**	....	**400**	**4,827**	**(4,427)**
Total Eastern Hemisphere (west of Suez)	**7,400**	**15,120**	**22,520**	**40,488**	**(17,968)**	**15,600**	**15,820**	**31,420**	**46,723**	**(15,303)**
EASTERN HEMISPHERE (east of Suez)										
Aden-Red Sea Area	....	....	....	63	(63)	....	....	....	66	(66)
Africa, East	....	....	....	293	(293)	....	....	....	351	(351)
Australia & Islands	....	500	500	2,937	(2,437)	250	500	750	3,551	(2,801)
Bahrein	....	....	....	3	(3)	....	....	....	3	(3)
Burma	1,000	500	1,500	203	1,297	1,000	500	1,500	238	1,262
Ceylon	....	....	....	148	(148)	....	....	....	175	(175)
China & Formosa	....	....	....	871	(871)	....	....	....	1,011	(1,011)
Hawaii	....	....	....	362	(362)	....	....	....	403	(403)
India & Pakistan	250	100	350	5,142	(4,792)	250	100	350	6,068	(5,718)
Indo-China	....	....	....	112	(112)	....	....	....	140	(140)
Iran	....	....	....	263	(263)	750	....	750	307	443
Iraq	....	....	....	30	(30)	....	....	....	33	(33)
Japan	....	800	800	2,934	(2,134)	....	800	800	3,455	(2,655)
Korea	....	....	....	Incl. in Japan		....	....	....	Incl. in Japan	
Kuwait	....	....	....	....	....	....	....	....	....	....
Malaya	....	....	....	345	(345)	....	....	....	449	(449)
N.E.I. Borneo-New Guinea	....	....	....	485	(485)	....	....	....	512	(512)
New Zealand	....	....	....	589	(589)	....	....	....	710	(710)
Philippines	....	....	....	562	(562)	....	....	....	638	(638)
Saudi-Arabia	....	....	....	30	(30)	....	....	....	33	(33)
Siam	....	....	....	137	(137)	....	....	....	181	(181)
Union of S. Africa	....	....	....	2,014	(2,014)	....	....	....	2,419	(2,419)
Total Eastern Hemisphere (east of Suez)	**1,250**	**1,900**	**3,150**	**17,523**	**(14,373)**	**2,250**	**1,900**	**4,150**	**20,743**	**(16,593)**
Total Eastern Hemisphere	**8,650**	**17,020**	**25,670**	**58,011**	**(32,341)**	**17,850**	**17,720**	**35,570**	**67,466**	**(31,896)**
TOTAL FOREIGN	**16,550**	**25,190**	**41,740**	**74,447**	**(32,707)**	**25,750**	**25,990**	**51,740**	**86,855**	**(35,115)**
United States	103,000	75,000	178,000	94,000	84,000	105,000	75,000	180,000	102,000	78,000
TOTAL WORLD	**119,550**	**100,190**	**219,740**	**168,447**	**51,293**	**130,750**	**100,990**	**231,740**	**188,855**	**42,885**

States will for some years continue to be the country with the greatest surplus of capacity versus the demand on it, both for internal usage and for export. There is little doubt that lubricating oil production in the United States will operate considerably below capacity because of world oversupply. It is probable that curtailment will occur largely in conventional type operations, particularly in the older, less efficient units.

Quality to an increasing extent will be a vital factor in the American market and, in the very best tradition of our industry, we shall continue to produce products at the lowest possible cost per unit of performance.

API Medical Group Presents Study On 18 Toxic Refining Chemicals

TOXIC PROPERTIES of 18 additional chemical substances handled or used in modern refineries are reported in the second series of Toxicological Reviews prepared by the Medical Advisory Committee of the Department of Safety of the American Petroleum Institute. The first series of reviews, covering 14 substances, was presented several months ago.(1)

All told, 32 chemicals used in petroleum processing, or toxic substances made from petroleum and handled in volumes in refineries, have so far been reviewed in the program. The purpose is to aid refiners in their precautionary measures to prevent the exposure of workers to toxic substances.

It is generally recognized that most of the materials encountered in the petroleum industry do no harm to those who contact them. A few, however, are capable of causing local or even systemic injury in cases where a sufficient quantity of a toxic agent remains in external or internal contact with the body for a sufficient length of time.

Poisoning occurring through skin contact, or inhalation, may develop insidiously over a long period, and without irritation of the skin or respiratory tract to establish relationship between exposure and effect. Prevention of such delayed or insidious poisoning depends on familiarity with the possible toxic effect of the various agents encountered, and on constant vigilance to keep contact on a safe level.

The toxic substances studied in the program of the API Safety Committee are of the following classifications:

Irritants: Gases, mists, vapors and dusts which injure the air passages or lungs and induce inflammation of the respiratory tract.

Asphyxiants: Two groups, which either mechanically exclude oxygen from the lungs when breathed in sufficient concentration, or interfere with oxygen transport by the blood or oxygen utilization by the tissues.

Volatile Drugs and Druglike Substances: These act after absorption by the blood and transportation to the tissues of the body.

Inorganic and Organometallic Substances: Substances such as inorganic phosphorus compounds or tetraethyl lead or iron carbonyl whose toxic effects vary widely.

The individual toxicological reviews are prepared by the Harvard School of Public Health, under the direction of Prof. Philip Drinker, a leading authority on industrial hygiene. Aiding in their preparation are the 20 members of the API Medical Advisory Committee, all oil company staff physicians.

The following 14 substances were covered in the first series of reviews: Aluminum Chloride, Boron Trifluoride, Chlorex, Cresol, Cumene, Furfural, Hydrogen Chloride, Hydrogen Sulfide, Iron Carbonyl, Nitrobenzene, Styrene, Sulfuric Acid, Toluene and Xylene. Table 1 lists the 18 substances included in the present reviews and gives brief data on them.

Selected information from the individual reviews is given below:

Acrylonitrile

Workers engaged in production of artificial rubber are most likely to be exposed, following escape of vapors or spills of liquid due to equipment failure. Laboratory workers also may undergo serious exposure, as acrylonitrile will vaporize readily unless kept in completely closed containers or systems. Any vapors resulting from handling should be removed by ventilation adequate to maintain concentration at or below 20 ppm.

Alkyl Disulfides

These may be produced by the mild oxidation of the corresponding mercaptans, and they may be present in small amounts, along with mercaptans, in high-sulfur crudes. Have little or no odor and may be found in some gasolines as a result of mild oxidation of alkyl mercaptans. Exposure will be primarily to the liquid, as they are all fairly high boiling.

Alkyl Mercaptans

Exposure most likely to occur in processing high-sulfur crudes; from leaks in lines and equipment used to collect gas from processing units and to distribute it as a fuel in the refinery, and when malodorants containing mercaptans are being added to fuel gas systems.

Small amounts of the higher molecular weight mercaptans (such as amyl mercaptan) are constituents of oxidation inhibitors for motor fuels and exposure may occur when they are being added.

Poisoning is more apt to be encountered as a result of exposure to the lower members of the mercaptan series because of their greater volatility.

Ammonia

Individual workers are most apt to contact ammonia during unloading of tank cars and transfer of substance to storage. Contact also may result from leaks in pipelines carrying anhydrous ammonia or aqueous solutions. Maintenance and repair crews are especially likely to be so exposed.

Liquid or gaseous ammonia should be handled in airtight, all-iron equipment capable of standing a pressure of 250 psi. gauge. Valves should seat fully when completely open or closed so that their stems can be repacked under pressure. Any operation or apparatus giving off ammonia fumes should be adequately ventilated. Waste ammonia water should be disposed of carefully in order to prevent its being a nuisance. Ammonia leaks can be controlled temporarily by spraying the vicinity of the leak with a hose in order to absorb or dissolve the gas.

Benzene

By far the greatest amounts used in refineries are blended into motor gasolines. Some is used as a solvent in commercial processes, and minor amounts are used in pilot plants and laboratories for solvent or reagent purposes. Exposure is usually limited to vapors.

Ventilation, either by dilution or local exhaust, should be designed to prevent toxic concentrations of vapors from reaching the breathing

How to Buy the Reviews

Copies of the 32 individual Toxicological Reviews sell for 25c each. Complete sets of the first series of 14 reviews sell for $3 and complete sets of the second series of 18 reviews, presented in the accompanying article, are $3.50. A standard ring binder, appropriately stamped, costs $5. Discounts are provided on single-quantity orders for shipments to a single address.

Send orders to Department of Safety, American Petroleum Institute, 50 West 50th St., New York 20.

TABLE 1—Properties of 18 Toxic Chemicals Handled or Used in Refining

Substance	How Used or Handled	Maximum Safe Concentration 8-Hr. Period	Principal Source of Exposure
Acrylonitrile $CH_2=CH-CN$	Agent in producing Buna-N type synthetic rubber	20 ppm.	Exposure through escaping vapor or through spills of liquid
Alkyl Disulfides R-S-S-R	May be present in high-sulfur crudes and some gasolines		Contact with the liquid when occurring in sulfur treating, or when used as lube oil additives
Alkyl Mercaptans R-S-H	Encountered in processing high-sulfur crude oils		Exposure from leaks in systems collecting gas from processing units
Ammonia NH_3	Used as refrigerant and for reduction of corrosion losses by neutralization of acidic materials	50 ppm	Through contact in unloading tank cars, transferring to storage and from leaks in refrigeration system pipelines
Benzene C_6C_6	Used as solvent in dewaxing, in laboratories and blending agent for gasolines	50 ppm	Usually limited to vapor exposure
Carbon Tetrachloride $C\ Cl_4$	Filler for fire extinguishers, and solvent	50 ppm	Exposure to vapors where ventilation is inadequate
Diethylene Glycol $C_4H_{10}O_3$	Constituent of dewaxing solvent		Contact in handling or following leaks in equipment; inhalation unlikely
Dowtherm A	Heat transfer agent		Contact with liquid as result of leaks
Kerosine			Considered hazard to consumers only through ingestion
Mercury Hg.	Used in recording and control instruments, and in laboratories	0.1 mg per cubic meter of air	Dangerous contact may occur through spillage, particularly in laboratories
Methyl Ethyl Ketone $CH_3COC_2H_5$	Solvent used in dewaxing and in laboratories	300-500 ppm	Minor degrees of exposure may occur through contact and inhalation
Morpholine	Used as corrosion inhibitor, or an emulsifying agent		Through contact when added to petroleum products
Naphthenic Acids	Extracted from petroleum fractions in refining		Not considered a refining hazard, but to consumers through contact
Normal Butyl para-amino phenol $C_{10}H_5ON$	Antioxidant in commercial gasolines		Contact as result of leaks or spills as it is being added
Phenol C_6H_5OH	Solvent in refining lubricating oils		Contact with liquid from leaks or sudden breaks in processing system; inhalation unlikely
Phosphorus Pentasulfide $P_2S_5(P_4S_{10})$	Oxidation inhibitor in refining, and in making lube oil additives		Through contact in handling; inhalation unlikely
Sulfur Dioxide SO_2	May occur in Edeleanu process or in acid treating	10 ppm	Exposure to vapor, skin contact unlikely
Thiophene C_4H_4S	Contaminant of benzene and of synthesis product	Chronic toxicity not yet established	Contact due to leaks in handling or in its manufacture

zone of workers. All apparatus and piping should be inspected regularly and systematically for leaks. Acute poisoning generally results from the inhalation of relatively high concentrations of vapor.

Carbon Tetrachloride

Mixtures containing 60% CCl_4 and 40% petroleum naphtha, or equal parts CCl_4 and benzene are non-inflammable. However, the CCl_4 evaporates more readily than the petrol-

eum fraction of such mixtures, so that originally non-inflammable mixtures may become dangerous on standing.

Principal use in the petroleum industry is as filler for fire extinguishers, but it is also employed to a minor degree as a solvent. Mechanical safeguards consist mainly of ventilation, either by dilution or local exhaust. Tanks which may be opened from time to time should be fitted with proper baffles and vents.

The use of carbon-tetrachloride fire extinguishers should not be discouraged, but certain precautions should be observed. CCl_4 may decompose into phosgene when played on a fire or red hot steel, and large amounts of CCl_4 will be volatilized in either case. Any individual using a carbon-tetrachloride extinguisher should leave the vicinity when the fire is out and a gas mask should be worn if prolonged exposure is unavoidable.

Diethylene Glycol

Used in refineries as a constituent of a dewaxing solvent. Inhalation is most unlikely as it has an extremely low vapor pressure at ordinary temperatures. Skin exposure may occur during careless handling or following equipment failure or leaks; however, diethylene glycol is essentially non-irritating to the skin.

Dowtherm A

Exposure limited to leaks from closed systems using the material as heat transfer agent. The relatively low vapor pressure of Dowtherm A and the marked sensory warning given by physiologically harmless concentrations suggests no concentration limits need be set other than those governing sensory acceptability.

Kerosine

Poisoning due to inhalation is not a factor, as the vapors have a low solubility in water and blood, thereby limiting the amount which will accumulate in the body. Kerosine poisoning is regarded as principally a consumer hazard through ingestion by children.

Mercury

Contact may occur in connection with use of mercury in recording and control instruments and similar equipment. Serious contact most often occurs in the laboratory, unless extreme care is taken to avoid spillage. Droplets of mercury falling on a dusty or slightly oily floor separate into smaller particles on impact and do not coalesce readily because of the dust or oil film which coats them. This results in a greatly increased surface area for volatilization and permits finely divided droplets to be stirred into the air with dust.

The cardinal aim of all safety precautions is the elimination of mercury vapor from the air. This can be done by maintenance of good housekeeping, to prevent the spilling or dissemination of metallic mercury on floors, benches, etc., and by the maintenance of the utmost cleanliness and neatness. Flowers of sulfur added to the sweeping compound can reduce contamination from floor particles. Evacuation of air which might contain mercury is an adjunct of secondary importance but one necessary in occasional situations.

In the design of laboratories and installation of equipment, wooden benches and floors with cracks should be avoided, as they tend to collect mercury. Work benches should be enameled steel or of similar smoothness and free from cracks and crevices. Walls and floors should be of a smooth, even hard finish, without cracks. It is also desirable to have floors sloped toward a covered sump or catch basin to which mercury can be drained or flushed.

Methyl Ethyl Ketone

Extensive exposure unlikely; some degree of exposure may occur in connection with the refining of lubricating oils, where MEK is used in combination with other solvents for dewaxing. It may enter the body by inhalation, ingestion or skin absorption, because it is an excellent fat solvent.

The usual safety measures employed in handling any volatile and inflammable solvent apply to MEK. Adequate ventilation is needed and direct contact should be avoided.

Morpholine

Contact may occur when morpholine is added to petroleum products, as it is used as a corrosion inhibitor or as an emulsifying agent (in the form of a soap or salt) and less commonly as an anti-oxidant. No instances of serious poisoning in the petroleum industry have been encountered.

Naphthenic Acids

Little opportunity occurs for contact with naphthenic acids during their separation from petroleum products, and purification, as all operations except acid treatment in agitators and drawing off of wash waters generally are carried on in closed systems. Consumers may have considerable contact with them, as the naphthenic acids are used extensively in the manufacture of paint dryers and emulsifiable cutting oils.

Normal Butyl Para-Amino Phenol

Used as an anti-oxidant in commercial gasolines, but not a hazard in finished gasoline, because of its low concentration. Significant exposure, as a result of leaks or spills when it is being added, is unlikely as the substance is generally transferred in a closed system under an inert gas.

Phenol

Where used in large amounts as a selective solvent for refining lubricating oils, or for extractive distillation of toluene, it is generally in closed systems, and contact is from leaks or sudden breaks with spillage of liquid phenol and subsequent skin exposure. Inhalation is unlikely.

Adequate means for immediately removing phenol from the skin should be available wherever possibility of such contamination exists, as it is a powerful and corrosive contact poison, absorbed rapidly through the intact skin.

Phosphorus Pentasulfide

Exposure to this substance or its compounds with various hydrocarbons may accompany its use as an oxidation inhibitor for oils and in the refining process. The material should be removed from skin by copious flushing with cold water. Care should be taken to prevent contact of P_2S_5 with moisture, as the primary hydrolysis product, H_2S, as well as the P_2O_5 and SO_2 produced, is toxic.

Sulfur Dioxide

Exposure to SO_2 vapor may occur during the Edeleanu process, during the restoration of sulfuric acid from acid-treating sludge, or from the escape of vapors from acid-treating equipment. Inhalation of more than 20 ppm by non-habituated individuals leads to the development of respiratory-tract inflammation. Long-continued exposure to low concentrations may lead to the development of chronic inflammation of the upper respiratory tract but has no serious systemic effects and does not seriously impair health.

Care should be taken to prevent any leakage of sulfur dioxide when it is used in either the liquid or vapor phase. Adequate ventilation should be provided to remove any SO_2 which escapes from operations involving its use or production, in order to keep the atmospheric concentration below 10 ppm.

Thiophene and Derivatives

An important contaminant of benzene, usually removed by sulfuric-acid treatment. Contact may occur due to leaks in the course of its handling or manufacture. Crude coal-tar benzene contains up to 0.5% thiophene. No reports are available on the chronic effects of repeated or prolonged exposure to low concentrations of thiophene.

References

(1)—"Toxic Properties of Refining Chemicals Listed by API Medical Committee", PETROLEUM PROCESSING, Oct., 1948, pg. 969.

Instrument Developments Lower Costs, Up Processing Efficiency, ISA Learns

By WILLIAM C. UHL, Equipment Editor, Petroleum Processing

NEW developments in instrumentation, many directed toward lower costs and increased efficiency in petroleum processing operations, were disclosed at the Fourth National Instrument Conference and Exhibit in St. Louis, Sept. 12-16.

Of 62 papers presented during the week's program, approximately 20 were of direct interest to the petroleum processing engineer and technologist. Information brought out in some of them included:

1. Operation of a complete refinery can be controlled by one, simple graphic-type instrument panel.
2. Fundamental studies have yielded considerable basic data concerning the proper location of control points on fractionating columns.
3. The infra-red spectrometer is increasing in value as a tool for the automatic control of processing units and equipment.
4. Shop layouts, tools, and testing equipment are of great importance to successful and efficient instrument maintenance.
5. Training programs likewise must be geared to produce the most skilled and efficient instrument mechanics possible.

8000 Registrants

The program of 20 different technical sessions was well attended by an estimated 8000 registrants at the Conference. However, the many unusual and improved instruments and accessory products displayed for the first time in public by 141 exhibitors in St. Louis' Kiel Auditorium also commanded much attention and comment. Among these products were:

1. A commercially-available instrument panel of the graphic type described above, for simplified control of one or more refinery units.
2. An electronic device for the remote gaging of as many as 24 oil or oil products storage tanks.
3. An automatic blender applicable to lubricating oils and capable of handling a large number of component streams.
4. Infra-red analyzers of several types, for gases or liquids and for recording and control purposes.
5. An air compressor designed specifically for instrument air, requiring no filters, oil traps, or aftercoolers.
6. Several new air-operated control valve positioners, one for heavy-duty valve service, another for standard service but with high sensitivity to very small changes in loading pressures, and with adjustable characteristics.
7. Improved instrumentation accessories, prefabricated housings, and the like, for lower installation and maintenance costs.
8. A temperature transmitter of the force balance type using a derivative action for unusually high speed of response.

Graphic Panel

The graphic-type instrument panel is finding a number of applications in the petroleum industry. One panel designed for a complete refinery and covering six individual units—crude and vacuum stills, catalytic cracker, fractionator, polymerization, and LPG units—was described in the paper, "Process Control by Graphic Panel," by David M. Boyd, Jr., Universal Oil Products Co. (The major portion of Mr. Boyd's paper was published in the September issue of PETROLEUM PROCESSING, p. 979).

This panel has been installed at the Indianapolis refinery of Rock Island Refining Corp., and has been on stream since Sept. 1. It required 1½ days for complete installation. A packaged unit, it was simply set in place and the thirty-odd double control lines, utilities lines, etc.—previously installed in the refinery—were then connected. To date, Rock Island has had no major operating problem since the start-up, according to Mr. Boyd.

Developed by UOP, panels of similar design are being built with varying degrees of coverage for one or more separate processing units all on one small board, and with simplified flow charts as an integral part of the panel. They are scheduled for, or in the process of, installation in several refineries, A. F. Sperry, president of Panellit, Inc., builders of the panels, told PETROLEUM PROCESSING.

Panellit's display at the Instrument Exhibit consisted primarily of a unit built for Wood River Oil & Refining Co. Other refiners scheduled to employ the device include Deep Rock Oil Corp., Cosden Petroleum Corp., Globe Oil & Refining Co., and Old Dutch Refining Co.

Simultaneously with the work done by UOP on this phase of instrumentation, Standard Oil Co. (Ohio), working in co-operation with the Lummus Co., also has been developing a graphic-type panel, according to Walter S. Bowers, of Sohio's technical service division, who participated in the discussion period following the presentation of Mr. Boyd's paper.

Use Console Design

The panel described by Mr. Bowers and shown on the screen in slide form, is a console-type, in an approximate U-shape with a desk or counter along the three inside walls. The operator sits at the center with the graphic control portion in front of him, and the recording instruments on the two side wings. In the UOP-developed, Rock Island panel, the design is a flat wall without a desk, and with the recorders in a row along the bottom.

Sohio is installing a two-section panel at its Lima refinery for control of the lube oil plant. Units cov-

Elect Oil Man President of Instrument Society

R. J. S. Piggott, chief engineer, Gulf Research and Development Co., was elected president of the Instrument Society of America at the meeting of the board of directors of the society in St. Louis on Sept. 10. An immediate past-president of the Society of Automotive Engineers (1948), Mr. Piggott has been active in instrumentation for many years and is responsible for a number of widely-known developments, such as the marsh buggy for geophysical explorations, a new device for measuring wall pressure of piston rings, and the effect of air in oil on altitude sealing of airplanes.

ered on the single panel are the furfural solvent refining unit and the solvent dewaxing unit. The vacuum unit which produces the feed for the furfural section will be controlled by a separate graphic panel, not part of the main console.

Considerable study was devoted to the problem before adoption of the installation now underway at Lima, Mr. Bowers stated. The company had done some work previously—in 1944—in the use of a graphic-type panel for its fixed-bed Houdry catalytic cracking units at Cleveland.

The advantages to Sohio of this new design in instrument panels are in basic agreement with those cited by Mr. Boyd of UOP. However, there are some possible points for a difference of opinion on the most satisfactory design approach, depending on individual processing unit conditions, Mr. Bowers told PETROLEUM PROCESSING.

Board vs. Field Mounting

For example, the question of board versus field mounting of controllers was brought up by V. V. Tivy, Foxboro, Co., during the discussion period. Mr. Boyd had described the use of board-mounted controllers, which require only two runs of tubing as against four runs for field-mounted controllers. In answer to Mr. Tivy, he explained that all controllers do not have to be in the board.

In the Sohio design, as explained by Mr. Bowers, one of the advantages is increased response speed by mounting controllers in the field. Other advantages, he said, include 1) minimizing upsets, 2) the panel is a training aid to both supervisor and operator, 3) operating personnel can be reduced because several units are combined in a single panel, 4) savings on installation costs can be realized amounting to 15 to 20% of total instrument investment costs, and 5) plot plan and layout of the refinery is improved with a smaller control room required.

There are naturally some disadvantages at this stage of development, Sohio has found. Flow diagrams need very careful planning. Sufficient space must be left on the board to provide for revisions in process arrangements. At present, there is a lack of competition among the suppliers and manufacturers of the component parts of a graphic panel. Progressive improvement in the design of components will come only through more active competition.

The basic concept of the graphic console panel, as explained by Mr. Bowers during the discussion period, is two-fold; all process indicators are in the operator's field of vision, and all controls are easily and quickly reached. In a phrase, this is visual co-ordination with fingertip control, he said.

He then outlined the five requirements Sohio feels are needed to make a console panel: 1) the instruments must be in the flow diagram, 2) the instruments must be equal to or better than conventional types in accuracy, readability, and ease of maintenance, 3) the operator must have both manual and automatic control from the panel board, 4) multiple point records are desirable to conserve space, show trends, and provide accounting records, 5) the console design is desirable for readability and control from a central location.

Control Point Location

Fundamental studies on the control of fractionating columns by Universal Oil Products Co. engineers have revealed that there are a number of generally accepted statements in the published literature which can be proved or disproved merely by calculation. This was brought out in the paper, "The Effect of Control Point Location upon Column Control," by K. D. Uitti, UOP.

A classic misstatement, he said, is that the temperature control point should be located in the column where the greatest change in temperature from deck to deck takes place. Working with a theoretical propane-isobutane feed at 200 psig. to an 18-deck column, feeding at deck No. 7½, the paper concludes that the most satisfactory instrumentation is a reflux-to-feed ratio controller, or a reflux rate flow controller, on the reboiler operating the heat input. This temperature controller also could be located part way up the column.

An interesting observation made by Mr. Uitti was that he could visualize in the future complete automatic control of fractionating columns by coupling proper control point location with some type of instrument which could analyze the incoming feed composition and thereby regulate the tower operation for feed variations.

Future Good for Infra-red

PETROLEUM PROCESSING discussed this subject with the chief instrument engineer of one major petroleum company who wished at present to remain anonymous. His firm has been doing considerable work on this problem. They have developed and have in use at present four infra-red spectrograph type analyzers which are recording feed compositions and controlling the operation of refinery towers. Based on their experience thus far, they are convinced of a bright future for infra-red controllers.

A number of infra-red analyzers were exhibited by instrument manufacturers at the ISA Show. Some are based upon, or represent improvements on, the so-called I.G. Farbenindustrie—Luft design. A brief description of one, the "Lira", follows.

Its operating principle is based upon the fact that most gases, vapors, and liquids absorb infra-red light in a portion of the spectrum which is specific for each product. The instrument measures the concentration of one component of a mixture, by measuring the infra-red light absorption of the mixture.

Each instrument is custom-built for the service to which it is to be applied. Measuring cells and filter cells may vary in length from 0.1 to 9.0 in., depending upon the characteristics of the gas to be analyzed and the sensitivity desired. Most cells are sealed with silver chloride windows; however, for certain applications these may be changed to sodium chloride, glass, mica, potassium bromide or other common infra-red windows.

Utilizing an infra-red light source

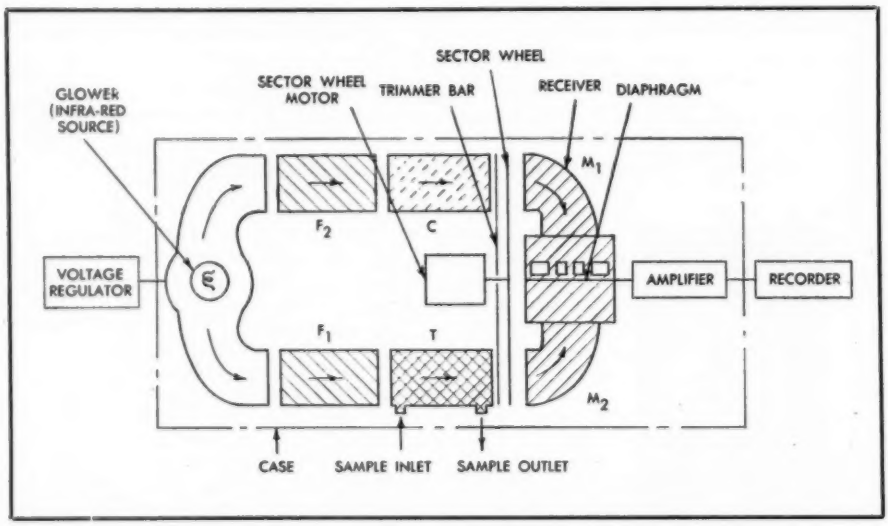


Fig. 1—Schematic arrangement of the "Lira" infra-red analyzer

consisting of nichrome wire heated to a dull red, the instrument's arrangement directs the infra-red rays in two separate beams by the polished inside walls of a stainless steel housing through filter tubes F1 and F2 (see Fig. 1), sample tube T, and compensator tube C, into the measuring chambers M1 and M2. The measuring chambers contain an infra-red absorbing gas. When this gas absorbs radiation its temperature and pressure increase.

Normally, the beams are equal in strength, the pressure increase in the two measuring chambers is equal, and no pressure difference exists across the diaphragm which separates the measuring chambers. However, when the gas to be analyzed is introduced into the sample tube T, the gas absorbs infra-red radiation and thus reduces the intensity of the beam passing through the sample tube. The pressure increase caused by this beam is less than the pressure increase caused by the unaltered beam, and a resultant pressure difference exists across the membrane of the diaphragm. This difference causes the diaphragm to move; the movement generates an electric signal which is amplified and registered by a recording voltmeter.

Interrupted radiation is employed to provide highest stability in operation. The two radiation beams are interrupted simultaneously, at a frequency of several cycles per second, by the rotating sector wheel. During the period in which no radiation enters the measuring chambers, the membrane assumes its rest position; when radiation enters the chambers, the membrane moves to a position determined by the pressure difference across it. Since the membrane is the moving element of a condenser microphone, an alternating current signal of the frequency of interruption is generated.

Room Temperature Has No Effect

Several advantages are cited as inherent in an instrument using interrupted radiation. Room temperature changes are not measured because the pressure difference across the membrane caused by these changes is of a much lower frequency than the interrupting frequency. In addition, it is possible to use a tuned alternating current amplifier of high stability.

Selective analysis is possible because different gases absorb radiation in different regions of the infra-red light spectrum. When the measuring chamber is filled with analysis gas, the detector becomes sensitive only to those spectral regions where this gas absorbs. Thus, secondary gases are not measured unless they are interfering gases; that is, gases which have absorption regions overlapping those of the analysis gas.

In those situations where measurement is desired of one component of a mixture which also contains interfering gases, identical filter tubes, filled with the interfering products, are placed in both light beams. In Fig. 1, such tubes are illustrated as F1 and F2. These filters absorb those regions of the infra-red spectrum where interference occurs, and thus the measuring chambers are made selective for the compound to be measured.

Instrument Shops

A case for proper planning in the layout of an instrument shop was presented by R. L. Nichols, general foreman, instrument department, Magnolia Petroleum Co., Beaumont, Texas, in his paper, "Instrument Shop Layouts."

Listed as essential to good layout are ten major areas: office, stockroom, tool room, storage, cleaning, heavy work (valves, etc.), light work (meters, gages), electrical and specialty, electronic, and training. Floor space devoted to each of these areas must of course be determined by the nature and scope of the work in each refinery. Smaller shops may find it practical to combine certain areas. Larger units may need additional space. As an example, Mr. Nichols explained that an area measuring 6 x 10 ft., devoted to a gage test set-up, including a high-pressure test stand, services approximately 20,000 gages.

Tools and testing equipment were discussed in papers by Francis S. Becker, Sun Oil Co., Marcus Hook, Penna., and Hart U. Fisher, Monsanto Chemical Co., Monsanto, Ill.

Mr. Becker described tools needed for a shop in a refinery of 100,000 b/d average capacity, employing 60 men in the department. He gave a detailed list of the minimum requirements in hand and power tools.

An estimate of the total cost of tooling a shop of this size was $5215, figuring on about $2550 for hand tools and $2665 for power tools. It also is based on an expenditure of about $1600 for a lathe. However, the quantity and quality of work demanded of the shop may warrant a more expensive lathe, because of the all-around importance of this one single tool.

Test equipment must be accurate and instrument personnel must be able to check on its accuracy, according to Mr. Fisher. Proper knowledge and training in the use of such equipment is essential, he emphasized. For instance, the optical pyrometer is an excellent device for measuring high temperatures. However, the object being checked must be under "blackbody" conditions, that is when

Maintenance Clinic to Be Repeated in 1950

With its original registration of 120 swelling to a final figure of 195, the pre-convention Instrument Maintenance Clinic held as a supplement to the regular program of the Fourth National Instrument Conference and Exhibit proved to be a popular feature to many ISA members. As a result, plans for next year's meeting in Buffalo include another such clinic; arrangements being made to accommodate 500 students.

Designed primarily to provide down-to-earth, practical information on a "how-to-do-it" and "how-to-repair-it" level, the 1949 Clinic received considerable favorable comments. A number of instrument engineers and department heads were seen in attendance, mingled with the mechanics and apprentices for whom the clinic was established originally. These men had come to investigate and were visibly impressed, according to comments heard later during the Conference week.

The clinic was held Sept. 9-11, the three days just preceding the Instrument Show, in classrooms set up at the Statler Hotel in St. Louis. Students bunked at the hotel under special rates arranged for by the ISA. The program comprised 10 two-hour sessions, three on Friday, four on Saturday, and three on Sunday. Each session, conducted in a separate classroom by each of the 10 instrument manufacturers who participated, included a lecture or conference followed by practical work with demonstration working models of the equipment under discussion. Ten groups of about 20 students each made the rounds of each classroom in a carefully arranged schedule.

The manufacturers and subjects covered by each follow: American Meter Co., integrating orifice meters, pneumatic transmitters and controllers; Bailey Meter Co., electronic instruments of the Wheatstone bridge type; Bristol Co., Series 500 air-operated controllers; Foxboro Co., Model 40 controller; Gow-Mac Instrument Co., thermal conductivity gas analysis equipment; Leeds & Northrup Co., multiple point recorders and pneumatic controllers; Manning Maxwell & Moore, Inc., pressure gages; Republic Flow Meters Co., flow instruments; The Taylor Instrument Cos., temperature transmitters; Wheelco Instruments Co., strip chart recorders of the galvanometer type.

Oil Industry Instrument Men on ISA Program

Mr. Nichols

Mr. Becker

Mr. Oberhelman

Mr. Uitti

Mr. Boyd

These five men were among petroleum industry instrument engineers who figured prominently in the technical program of the Fourth National Instrument Conference and Exhibit in St. Louis, Sept. 12-16. R. L. Nichols is with Magnolia Petroleum Co. at Beaumont, Texas. F. S. Becker is at the Marcus Hook, Pa., refinery of Sun Oil Co. L. E. Oberhelman's connection is Standard Oil Co. (Indiana), Sugar Creek, Mo. K. D. Uitti and David M. Boyd are associated with Universal Oil Products Co. at the Riverside, Ill., laboratories. Nichols and Becker presented papers during the Maintenance and Operation Sessions of the ISA program. The other three men were on the program of the Production Processes Instrumentation sessions of the ISA. Mr. Boyd has been named chairman of this latter section for the coming year and will be concerned with that phase of the program in 1950.

it is completely surrounded by objects all of which are at the same temperature. With an optical pyrometer, an operator could easily obtain an erroneous temperature reading of 720° F. for a block of ice, because the ice block does not fulfill the blackbody requirements.

Among new products shown in the Exhibition Hall in St. Louis, in addition to the graphic panel and the infra-red analyzers, were two new valve positioners. One, designed for heavy-duty control valves with stem loads up to 10,000 psi., employs a reversible pneumatic motor and a gear-driven screw stem, in place of the conventional diaphragm motor or piston type operator. Another utilizes variously shaped positioning cams with a diaphragm motor to obtain direct and reverse action and to provide varying characteristics in stroke speed from the square to the square root.

A new flow meter features a magnetic clutch to transmit the movement of the float instead of the conventional mechanical arrangements. The principle is not new, but its development is said to have been hampered by the non-availability of high-power magnets and non-magnetic metal wall material of sufficiently high tensile strength, both of which are now obtainable. More power with less friction is claimed as the advantage of this method of operation due to the meter's relatively large float and long float travel. No stuffing box is required as is usual with a mechanical meter.

One manufacturer showed a new electronic instrument for the remote gaging of oil storage tanks. Comprising a transmitter, connected directly to the tank gage piping, and a receiver, the device is provided in two models, handling up to 24 individual tank readings. Accuracy of within 1/16th in., for a scale up to 54 ft. is provided. (For further details, see PETROLEUM PROCESSING, "What's New!" July, 1949, p. 820, Item 9).

Instrumentation accessories also came in for their share of attention at the ISA Show. One company, manufacturers of housings and pumps for the service station end of the petroleum industry, has developed and adapted these housings for use in the refinery. In shapes applicable to housing flow meters, instrument manifold assemblies, and various field instruments, these metal cabinets can be wall-mounted, horizontal or pedestal pipe mounted, and can be installed without the use of tools, it is said. They are weather-proof and insulated with foil covered asbestos. A hinged door provides easy access to the interior.

Continued progress was reported on the work of the Instrument Society of America's Recommended Practices Committee at its meeting in St. Louis, Sept. 9, preceding the Instrument Conference. In addition to announcing the adoption of the recommended practice on instrument flow plan symbols, R.P. 5, the Committee has begun to correlate its work with other technical and scientific groups concerned with like problems. For example:

1. The Committee requested the Board of Directors of the ISA to take the necessary steps for affiliation of the ISA with the American Standards Assn.

2. The sub-committee on flow plan symbols, R.P. 5, is working now with the British Standards Institution, with the aim of eventual agreement on standardized symbols. Further work has been planned in the direction of surveying nomenclature, definitions, etc., not only with the British group, but also the National Electrical Manufacturers' Assn., the Instruments and Regulators Division of the American Society of Mechanical Engineers, the Scientific Apparatus Makers' Assn., and the American Institute of Electrical Engineers.

The Scientific Apparatus Makers' Assn., working in conjunction with the ISA sub-committee on pneumatic transmitter and controller usage, R.P. 6, has recommended to the ASA that a standard be adopted for maintaining air pressure range of pneumatic instruments in the 3 to 15 psi. range. Most SAMA members now are manufacturing such instruments to conform to that range.

The ISA Board of Directors selected Buffalo as the site for the Fifth National Instrument Conference and Exhibit, to be held in the Municipal Auditorium, Sept. 11-15, 1950.

Details on New Devices

Many new instruments and accessory devices exhibited at the Fourth National Instrument Conference and Exhibit received widespread attention by petroleum industry instrument engineers in attendance. Readers who are interested in further details on some of these products, mentioned briefly in the foregoing article, are directed to turn to this month's "What's New!" section, beginning on page 1137.

Causes and Cures for Explosions In Compressed Air Systems

EXPLOSIONS which occur in compressed air systems are rare but not unusual occurrences in industrial installations. The cause has been ascribed to various possible factors but in the main still remains an unsolved mystery.

In the oil industry it has occurred in numerous natural gasoline plants and refineries. The subject was one for lengthy discussion in the "Information Please" sessions of the Natural Gasoline Assn. of America conventions in 1946 and 1947, and now is being more thoroughly investigated by that organization.

The explosion hazard is not the only one encountered. The possible formation of carbon monoxide—without the occurrence of an explosion or obvious evidence that some form of combustion is occurring within the system—also might be serious when the air is used in confined spaces where personnel are at work, or to supply fresh-air masks and similar equipment.

The U. S. Bureau of Mines has recently concluded an investigation* of the subject, finding that a "carbon-oxygen complex" is formed on carbon deposits in air compressors. The theory of the existence of such a complex, the formation of which is exothermic, long has been accepted as the explanation of the spontaneous heating of coal, according to the Bureau. While the Bureau scientists do not necessarily regard the demonstration of the complex's existence in compressed air systems as indicating a remedy, they do regard it as a possible cause.

Among the explanations which have been advanced for compressed air system explosions may be included the ignition of oil vapor-air mixtures created in the system by high temperatures, or the vapors from oil cracked by the high temperatures; static electricity igniting combustible materials in the system; formation of organic peroxides in the lubricating oil, leading to further exothermic oxidation reactions, and possible cata-

* "The 'Carbon-Oxygen Complex' as a Possible Initiator of Explosions and Formation of Carbon Monoxide in Compressed-Air Systems," U. S. Bureau of Mines Report of Investigations 4465, by H. W. Busch, L. B. Berger and H. H. Schrenk, June, 1949.

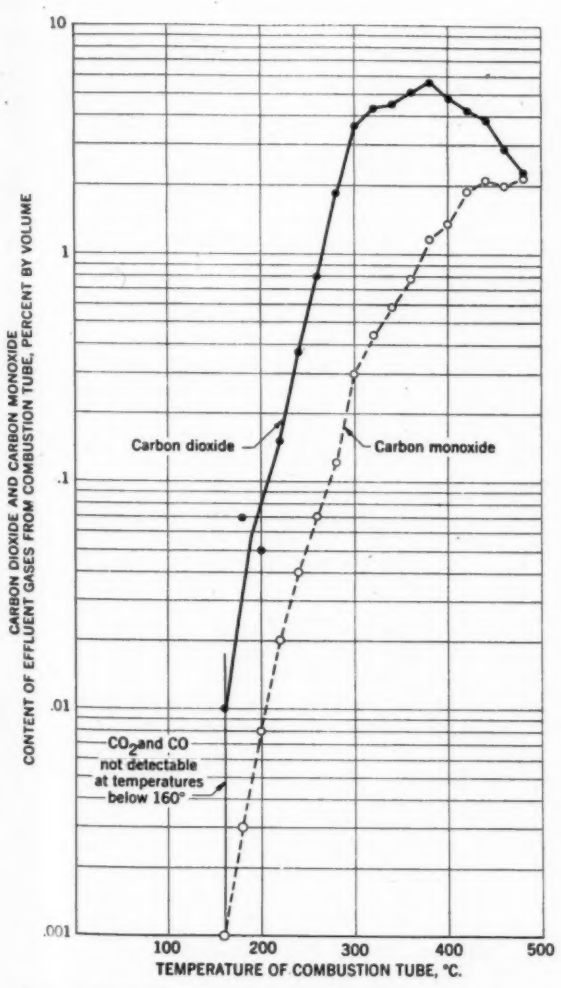


Fig. 1—Evolution of CO and CO_2 by carbon taken from an air compressor, when heated in a stream of nitrogen

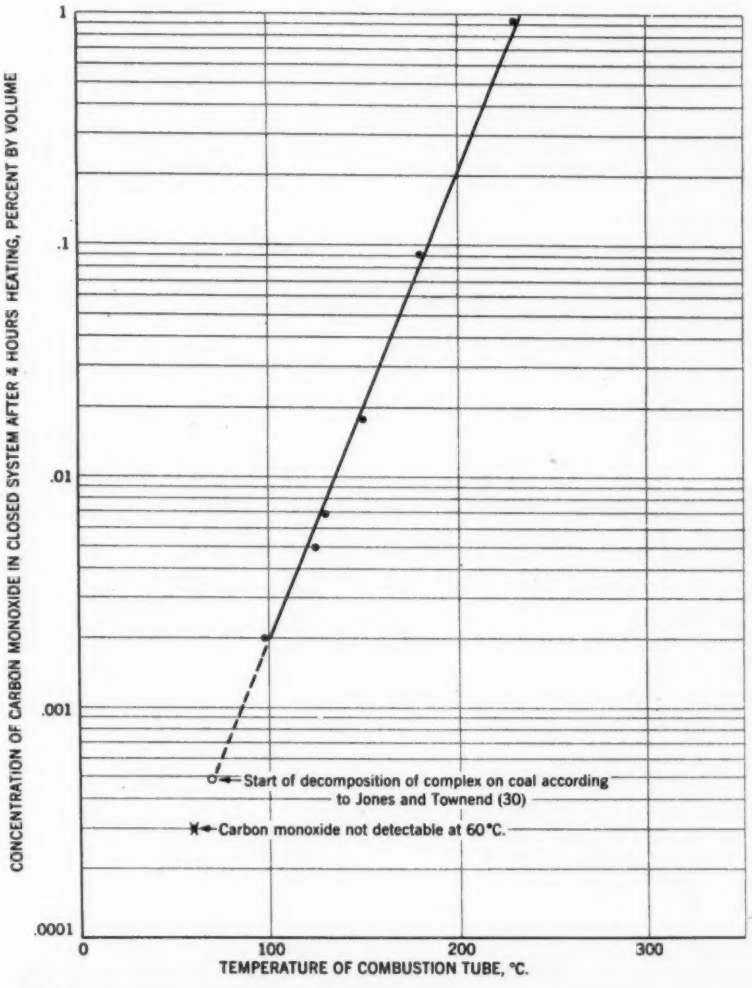


Fig. 2—Concentration of CO produced by air compressor carbon deposits when heated in air in a closed system for four hours at different temperatures

lytic effect of metal particles on oxidation reactions.

Several investigators have shown theoretically and experimentally that quite high temperatures may develop in air compressors having leaky exhaust valves. The air leaking back from the receiver into the cylinder, because of a faulty discharge valve, does not cool during the intake stroke of the piston; therefore the air in the cylinder at the start of the next compression stroke is at an abnormally high temperature. This temperature is, of course, increased during the succeeding compression stroke and tends to increase progressively with each stroke thereafter.

Any substance present which could be "triggered" or activated to exothermic reaction at rather low temperatures, consequently, could be the initiator of an explosion. Investigations with various types of carbon, including coal, indicate the complex is exothermic during formation and will decompose into carbon dioxide and the monoxide between 70 and 350° C. (158 to 662° F.).

The Bureau scientists experimented with three samples of carbon taken from compressed air systems, finding them each to contain a considerable quantity of oxygen. Compositions of these samples are given in Table 1. Sample A was obtained from the discharge pipe of a two-cylinder single-stage compressor supplying air at 40 psig. The deposit was hard, black and oily, and had to be chiseled from the interior of the pipe. Sample B, obtained from the low-pressure stage discharge valve of a large two-stage compressor delivering air at 102 psig. from the second stage, was soft, extremely oily and could not be sized. Sample C, from the same compressor, was taken from intake and discharge valves of the high pressure cylinder and also found to be soft, but less oily than Sample B.

Evidence of Exothermic Reaction

Experiments indicated that when these samples were heated, either in the presence of air or nitrogen, carbon dioxide and carbon monoxide were given off. The samples when heated in air showed unmistakably the existence of an exothermic reaction and the consumption of oxygen. In air, the presence of the oxides of carbon reached a peak in the neighborhood of 350° C. (701° F.), while they could not be detected at temperatures below 160° C. (320° F.).

TABLE 1—Composition of Three Carbon Deposits from Air-Compressors

Constituent	Ultimate Analysis, % by weight, as received Carbon A	Carbon B	Carbon C
Moisture	5.9	...	...
Hydrogen	2.7	5.4	5.1
Carbon	54.2	49.1	53.1
Nitrogen	0.1	0.0	0.0
Oxygen	34.1	15.3	20.0
Sulfur	0.5	0.5	0.8
Ash	8.4	29.7*	21.0**

* Further ash analysis indicated composition of 1.4% silica, 21.4% iron oxide (Fe_2O_3) and 6.9% undetermined.

** Further ash analysis indicated composition of 1.5% silica, 15.9% iron oxide (Fe_2O_3) and 3.6% undetermined.

All three samples contained particles of metallic iron.

When the samples were heated in nitrogen, evolution of carbon oxides again was detected at 160° C. and the rates, Fig. 1, were the same as in air up to 300° C. (572° F.), whether heated in air or nitrogen. The Bureau scientists concluded this is an indication that the decomposition of the complex is a reaction of the same type in both instances and is caused by temperature, being unrelated to presence or absence of oxygen in the surrounding atmosphere. More decomposition gases were released when the sample was heated in air, indicating the simultaneous formation and decomposition of the complex when heated in the presence of oxygen. The only reaction of the heated sample in an inert atmosphere was decomposition of the complex existing on the carbon from previous contact with air in the compressor system.

Further experimentation with more elaborate equipment, yielding the data plotted in Fig. 2, show that carbon monoxide (taken as evidence of carbon dioxide also, since it was the most sensitive analytical detection method available) was not detectable at 60° C. (140° F.), and begins sometime before a temperature of 100° C. (212° F.) is reached.

The rate of decomposition is shown to bear an exponential relationship with temperature and appears to increase ten times for every 50° C. increase in temperature. Corroborative data show an appreciable increase in oxygen consumption when the temperature exceeds 150° C. (302° F.). Direct evidence of an exothermic reaction was noted with the sample heated in air, while no such evidence was found when using an inert atmosphere, as shown in Fig. 3.

Bureau scientists suggest in the report that possible prevention measures include development or selection of lubricants which minimize or inhibit the action of the carbon-oxygen complex. It is stated also that the use of automatic, temperature-sensitive shut-off mechanisms, to prevent development of excessive temperatures in discharge lines, should prove effective in averting accidents.

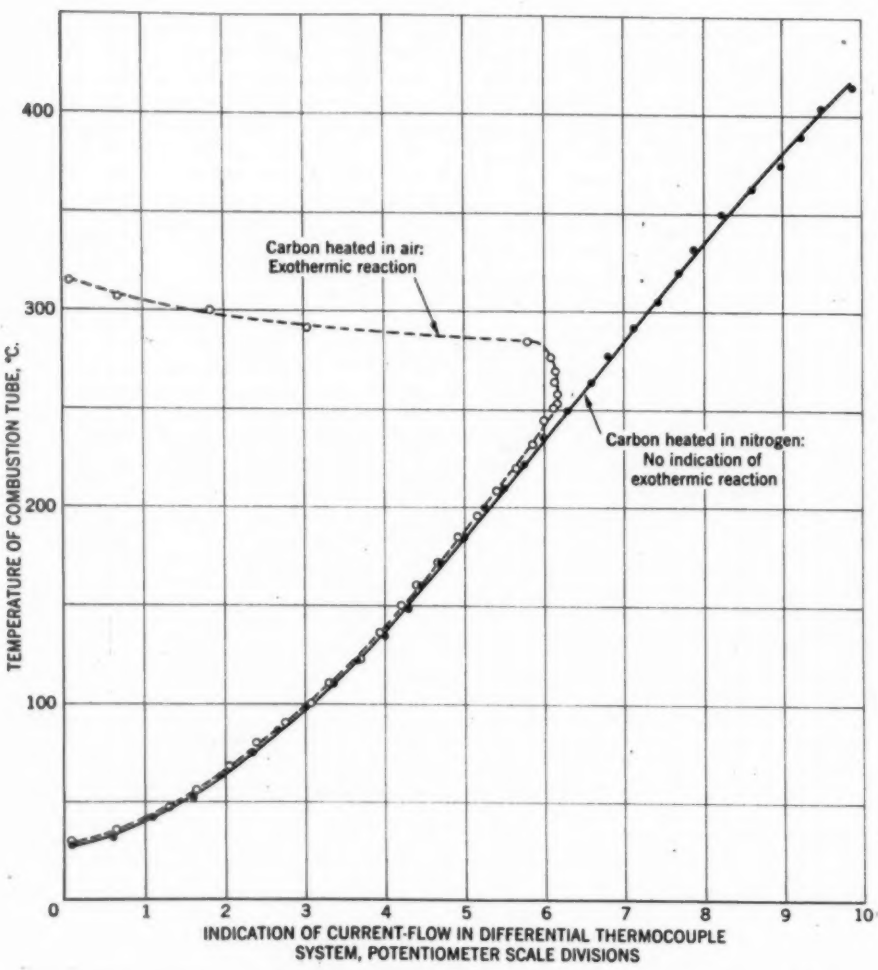


Fig. 3—Comparison of carbon samples heated in air and nitrogen, showing definite indication of exothermic reaction under former conditions

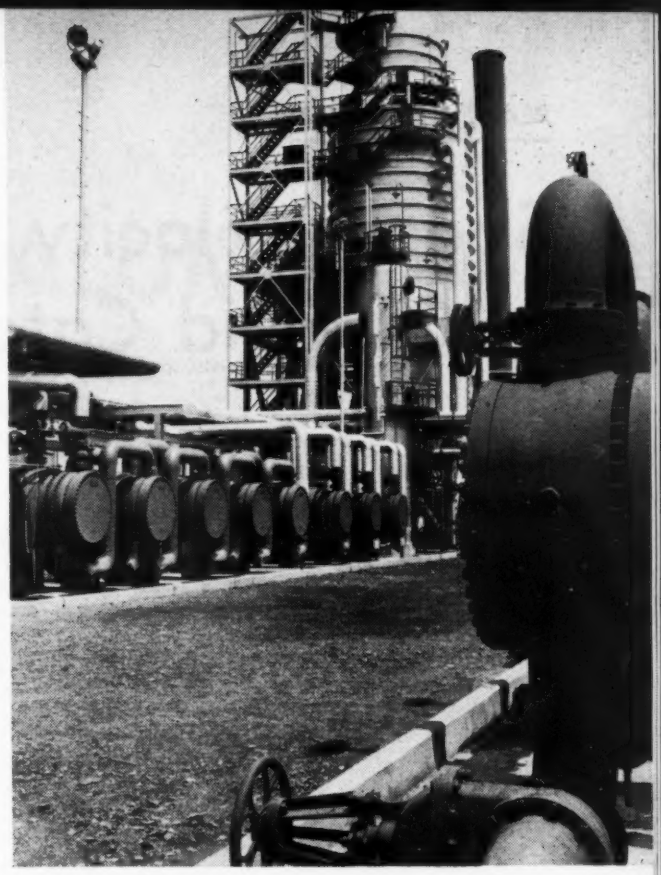
THIS MONTH'S COVER STORY

Dedicate Bigger Bayway During Oil Progress Week

LARGEST vacuum pipe still ever built, 49,000 b/d design capacity, will be dedicated Oct. 17 at Esso Standard Oil Co.'s Bayway, N. J., refinery, along with a new 41,000 b/d Fluid catalytic cracking unit and other portions of the company's expansion program. Formal ceremonies will take place at the plant, and are timed to tie in with the nation-wide Oil Progress Week.

Bayway's expansion program includes the vacuum still (shown at right), the new Fluid unit (shown below in an architect's drawing), an adjacent light ends unit operated in conjunction with the cat cracker, and a 260,000 lbs./hr. steam boiler. The vacuum still was designed primarily to operate on reduced crude from the existing crude units at the refinery, and is aimed at decreasing the amount of residuals and increasing the yield of gas oil feed for the new cat cracker.

The 93-ft. tower of the still comprises three sections: 1) the lower or stripping section; 2) the center which consists of a flash zone, a wash section, and a lower pump-around and product-condensing and removal section; and 3) the top or upper pumparound and product-condensing and withdrawal section.

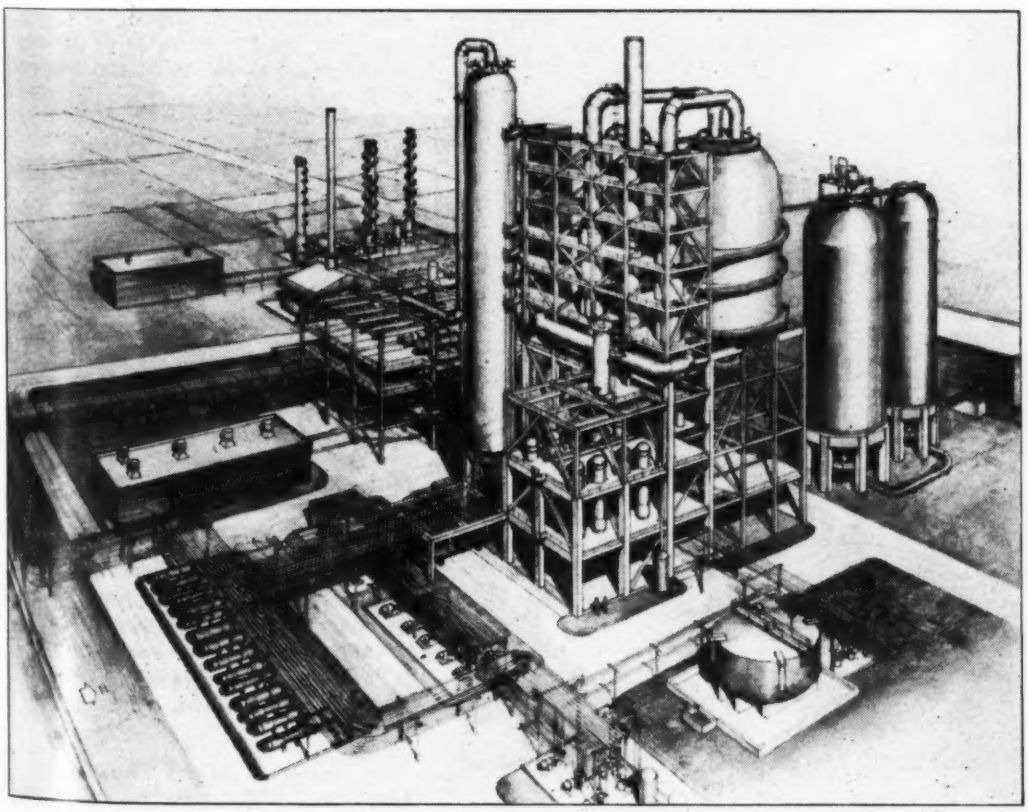


Esso's new vacuum pipe still, with part of the battery of shell-and-tube heat exchangers in the foreground, which provide almost 35,000 square feet of heat-transfer surface

The 41,000 b/d design capacity Fluid unit, although considerably larger than others built for the industry thus far, has been made more compact in structural design, and will not be as tall as some units of lesser capacity. Reactor vessel is 35 ft. in diameter and 41 ft. in height. Catalyst storage hopper has space for 1600 tons of catalyst, 1020 tons of which will be in constant circulation through the Fluid unit.

The Bayway projects are all part of an overall refinery expansion program for the Esso Atlantic and Gulf Coast plants.

Esso's Oil Progress Week program includes tours of the new faciilties for employes and families on Oct. 15 and 16, and the formal dedication on Oct. 17. The balance of the week and for several weeks following, numerous tours are scheduled for civic groups, service clubs, and government groups from the surrounding area.



The Fluid catalytic cracking unit at Bayway, shown in the architect's drawing at the left, has a charge capacity of 41,000 b/d and is the largest Fluid unit yet erected. Regenerator measures 55 ft. in diameter and 35 ft. in height. Catalyst lines are 9 ft. in diameter and will circulate catalyst at the rate of 47 tons per minute

Space Velocity Charts Aid Operation Of Fluid Catalytic Cracking Units

By J. H. GARY, Technical Service Division
Standard Oil Co. (Ohio)

MOST important variable in the operation of a Fluid catalytic cracking unit is the weight hour space velocity (WHSV). Weight hour space velocity is, by definition, the oil flow, in lbs./hr., divided by the amount of catalyst present in the reaction zone, in lbs.

The WHSV is easily varied by regulating the depth of the catalyst bed in the reactor. The greater the depth of the catalyst bed, the longer the oil is in contact with the catalyst and, consequently, the greater the percentage of gas oil feed cracked. A decrease in WHSV results from an increase in depth of the catalyst bed when the oil flow rate remains constant.

Information available to the operator of a unit from the instrument readings does not include the rate of oil flow in weight units or the lbs. of catalyst in the reaction zone. The above definition of WHSV expressed in terms of data available to the operator is:

$$\frac{\text{(Oil flow, b/d)(Sp. gr.)(8.33)(1.75)}}{\text{(Cat. in reactor, cu. ft.)(Bed density, lb./cu. ft.)}}$$

Alignment charts have been constructed in order that the operators may have a quick and convenient method of determining weight hour space velocity from instrument data. Fig. 1 is used to determine the WHSV for a 30.7° API oil. Fig. 2 corrects the WHSV determined on Fig. 1 for an oil feed gravity other than 30.7° API.

For example, it is desired to find the WHSV on a Fluid unit when the reactor bed volume is 9000 cu. ft., reactor bed density is 26 lb./cu. ft., oil flow rate is 33,000 b/d, and the oil gravity is 25° API. In Fig. 1, connect the 9000 cu. ft. point on the Reactor Bed Volume scale with 26 lb./cu. ft. on the Reactor Bed Density scale and locate a reference point on the Reference Line. Draw a line from 33,000 b/d on the Feed Rate scale through this reference point, and read the WHSV on that scale—1.8 for a 30.7° API oil.

On Fig. 2, connect 1.8 on the WHSV scale with 25° API on the Feed Gravity scale to read a WHSV of 1.85 for a 25° API oil on the Corrected WHSV scale.

These charts may be used to find the WHSV on either the fresh oil feed or the total feed, provided the appropriate feed rate and gravity are used.

Readers who desire working-size copies of the charts can obtain them, without charge, upon request to the editor of PETROLEUM PROCESSING.

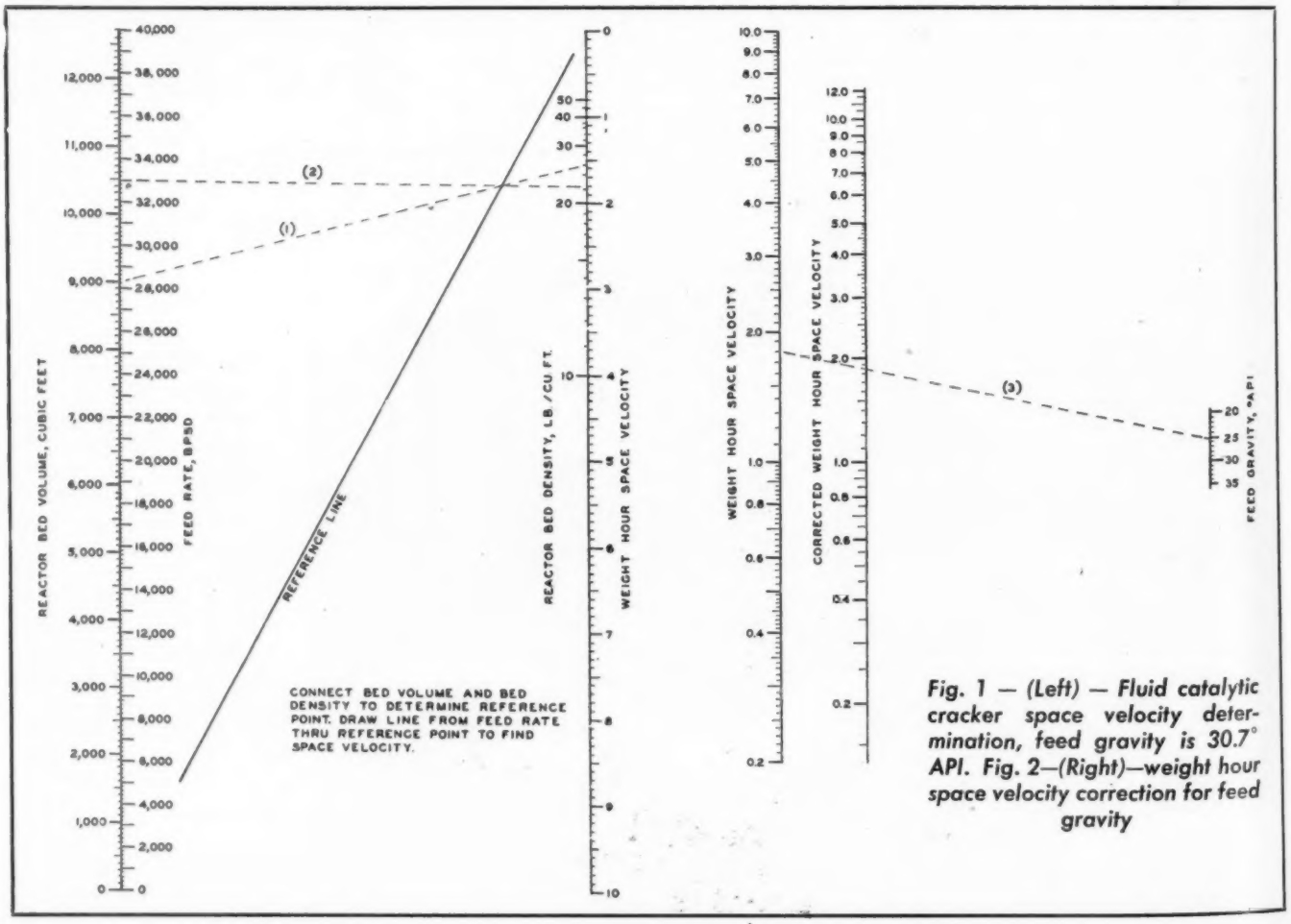

REACTOR BED VOLUME, CUBIC FEET
FEED RATE, BPSD
REFERENCE LINE
REACTOR BED DENSITY, LB./CU FT.
WEIGHT HOUR SPACE VELOCITY
CONNECT BED VOLUME AND BED DENSITY TO DETERMINE REFERENCE POINT. DRAW LINE FROM FEED RATE THRU REFERENCE POINT TO FIND SPACE VELOCITY.
(1)
(2)
WEIGHT HOUR SPACE VELOCITY
CORRECTED WEIGHT HOUR SPACE VELOCITY
(3)
FEED GRAVITY, °API

Fig. 1 — (Left) — Fluid catalytic cracker space velocity determination, feed gravity is 30.7° API. Fig. 2—(Right)—weight hour space velocity correction for feed gravity

NEW USES FOR ALUMINUM

By B. J. FLETCHER, Chief Engineer Development Division, Aluminum Co. of America

The applications of aluminum and aluminum alloys in the petroleum industry are reviewed. Use of the alloys in tank roof and top shell rings provides corrosion protection where sour crudes are stored. Development of a method for field welding is bringing the metal into use in pipelines. Aluminum alloys find use in heat exchanger tubes, and clad tubes have been developed for specific corrosion conditions. Aluminum sheet is used to cover thermal insulation on vessels, towers and the like. For the cathodic protection of buried lines and vessels a packaged galvanic aluminum anode supplies a chemically treated backfill which provides the required environment of reduced resistance.

THE desirable characteristics of aluminum and aluminum alloys are gaining increased recognition in the petroleum industry. In one form or another, the metal can be found in every phase of the industry from the oil field to the service station. Some applications have been in use for more than 20 years, while others are more recent adaptations of the metal.

Aluminum's high resistance to corrosion, its light weight, and its good workability have been recognized for a long time. In addition to these qualities, alloys have been developed which have great strength, and the cost of aluminum products has been reduced to a point where they are now serious competitors of the older materials. The following discussion gives some idea of the metal's versatility in petroleum industry applications.

Refinery Equipment

In the refinery, aluminum has proved successful for bubble caps and trays, and condensers. Alclad 3S (see table) is used in condensers because of its high resistance to pitting attack by most waters. Flame arrestors of aluminum, as well as aluminum roofs for storage tanks and rundown tanks, also find service in the refinery. Roofing, siding, and sheathing for insulated pipes and towers of this material have found increasing use as well.

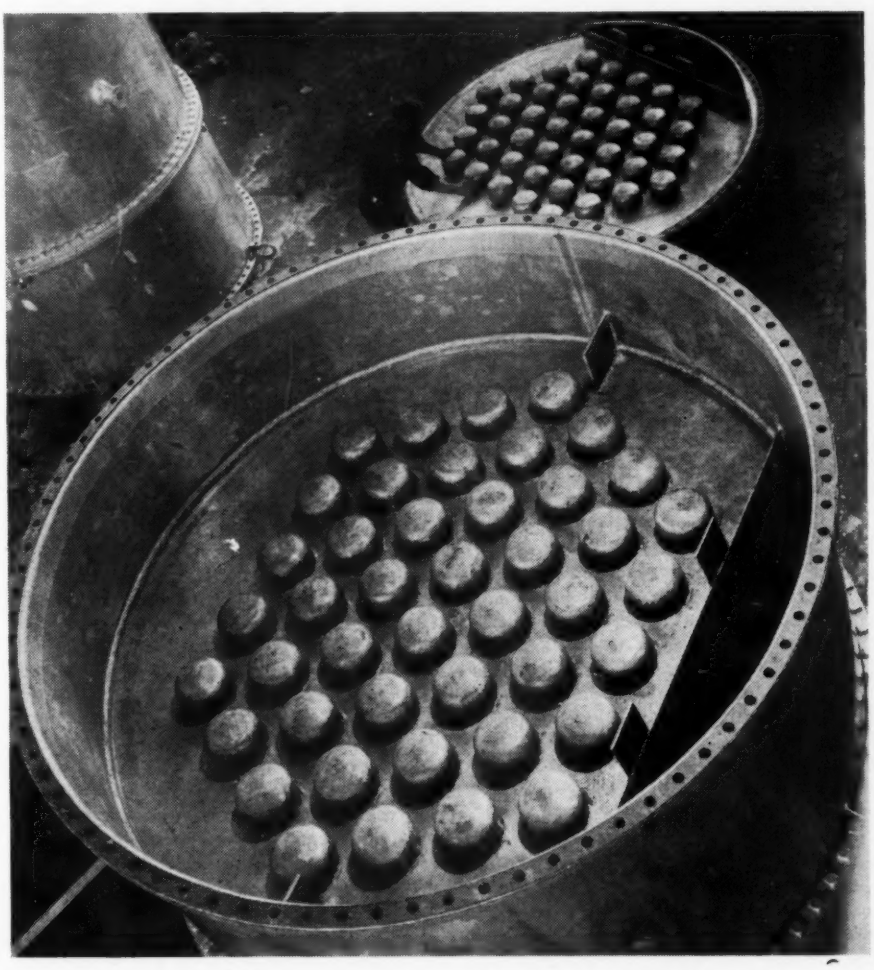
Truck tanks of the alloys combine resistance to corrosion by the oil cargo and weight savings with a resulting increase in payload. The alloys have the added advantage of not catalyzing the decomposition of oils and fuels.

Storage Tanks

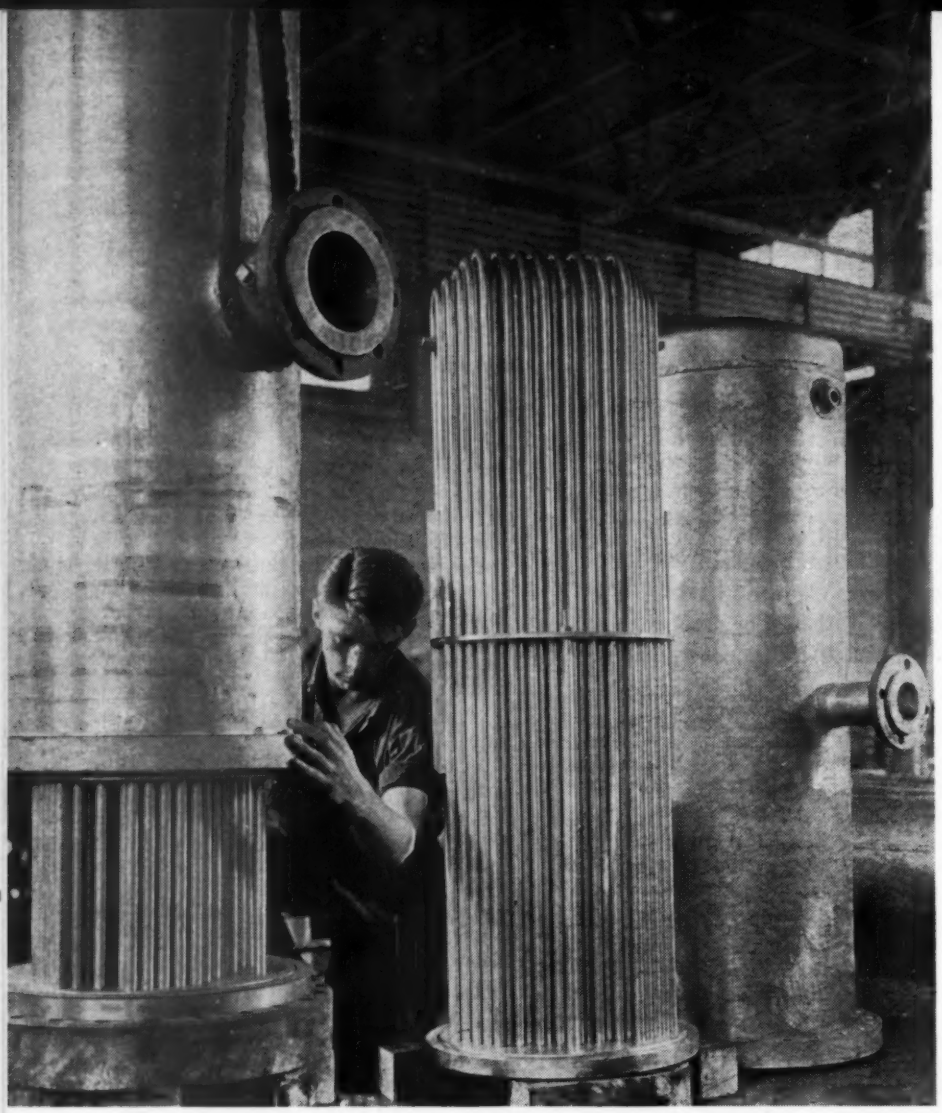
Oil producers and tank manufacturers have shown much interest in the use of aluminum alloys for storage tank roofs. Twenty years of satisfactory service give aluminum a unique position in this field. It offers high resistance to the corrosive effect of vapors, principally hydrogen sulfide, given off by sour crudes. When used for the roof and the top ring of the shell, corrosion is reduced and the fire hazard from the rapid reaction of sour crude gases and steel is eliminated. Also it prevents the formation of iron-sulfur compounds which would normally fall to the bottom of the tank and shorten the life of the tank bottoms.

The light weight of aluminum reduces tank transportation and erection costs, and its non-sparking property eliminates another cause of fires. Good appearance is also an important property of the metal in connection with storage tanks. Ladders and walkways of this material around storage tanks afford a good appearance and reduced maintenance.

Alloy 61S-T6 structural shapes and



Large aluminum bubble cap plate being fabricated for an absorption tower



Shop assembly of heat exchanger with aluminum tubes

sheets are recommended for roof framing. Sheet and plate for decks and top rings can be 61-S-T6 or, in some cases, lower strength alloys. Painting is not required for tanks constructed of the alloy mentioned above, although it may be advantageous to paint tanks located near tropical seacoasts after several years exposure. The structural framework of a roof is usually assembled with bolts, while the sheet and plate can be welded advantageously.

Aluminum roof construction affords an economical means of combatting corrosion by sour crude vapors, since the roofs last several times as long as steel roofs. Past experience indicates aluminum roofs for sour crude storage tanks can be sold at a price which will give the operator lower annual costs and the manufacturer an increased profit per tank.

Pipelines

Conditions affecting the use of aluminum in petroleum pipelines and piping systems have changed considerably the past few years. The initial cost of aluminum pipe now compares more favorably with that of steel pipe, improved alloys meet the rugged requirements for this application, and a practical method of welding the pipe in the field has been developed. Several experimental, field-welded aluminum pipelines were laid successfully during 1948.

Aluminum pipe of standard sizes through 12-¾ in. O.D. is produced by direct extrusion. This process results in a uniform, smooth product whose maximum length is limited only by the weight per foot of the pipe and the size of the billet which the extrusion press can handle. The pipe can be beveled or threaded, and a variety of threaded and welding fittings is available.

The recent introduction of the argon-shielded tungsten arc method of welding has made possible the practical field joining of aluminum pipe. This process eliminates the need of a flux and permits welding in any position. The inert argon gas blankets the weld pool and prevents the formation of aluminum oxide film. Filler wire is usually an aluminum alloy containing 5% silicon. Portable welding units are available and their operation in the field has proved economical and simple. The light weight of aluminum is an advantage in laying pipe particularly in areas where transportation is a problem. A 40-ft. length of standard 4-in. aluminum pipe, for example, weighs only 149 lbs., compared to 432 lbs. for a similar steel pipe; the same length of 6-in. pipe weighs only 262 lbs., compared to 759 lb. for steel. This characteristic of aluminum pipe saves labor and time. In addition, its smooth surface makes it easier to handle.

Aluminum alloys are available which afford excellent resistance to corrosion under many conditions in pipeline service. Two such alloys are 63S-T6 and 61S-T6, both of which are not only resistant to corrosion but also withstand ordinary pipeline pressures.

The cost of buried aluminum pipelines must take labor, materials, transportation and installation into account. Considering all these factors and basing pipe costs on mill prices, it appears that the cost of completed aluminum pipelines will be about one half more than that of similar steel lines. The final evaluation of cost, therefore, depends on the relative life of aluminum and steel pipelines.

Cathodic Protection

Aluminum and its alloys had been associated with the broad field of cathodic protection for many years before their application to the protection of steel pipelines and other buried steel structures was considered.

Tests have indicated the performance of aluminum anodes is improved by the use of chemically treated backfills which provide an environment of reduced resistance, reduce local action, and minimize polarization. In order to provide this backfill in a simpler manner, a packaged galvanic aluminum anode has been developed. Here the usual metal anodes are encased in mortar-like or concrete-like materials which contain the necessary chemicals to assure the desired anode performance. These packaged anodes provide a proper, uniform environment for the anode, reduce technical supervision for installation, and installation time.

Protection of buried steel structures by galvanic anodes is a comparatively new field in which there is still much research and development to be done. Aluminum is suited in many ways for use as galvanic anodes. It has the lowest electrochemical equivalent weight of the commercial metals which are feasible for galvanic anodes and, in proper backfills or packages, has a sufficiently anodic potential to protect steel. This implies that less aluminum would be used in delivering a given amount of protective current

TABLE 1—Typical Mechanical Properties of Some Wrought Aluminum Alloys

Alloy and Temper	Tensile Strength, Psi.	Yield Strength (Offset = 0.2%) Psi.	Elongation —Per Cent in 2 In.— Sheet Specimen (1/16-In. Thick)	Elongation —Per Cent in 2 In.— Round Specimen (½-In. Diam.)	Brinell Hardness 500-Kg. Load 10-mm. Ball	Shearing Strength, Psi.
28-O	13,000	5,000	35	45	23	9,500
38-O	16,000	6,000	30	40	28	11,000
38-H14	21,500	19,000	8	16	40	14,000
38-H18	29,000	26,000	4	10	55	16,000
48-O	26,000	10,000	20	25	45	16,000
52S-O	27,000	12,000	25	30	45	18,000
61S-O	18,000	8,000	22	30	30	12,500
61S-T6	45,000	40,000	12	17	95	30,000
63S-T5	30,000	25,000	12	..	65	18,000
63S-T6	35,000	30,000	12	..	73	22,000

than would be the case for other possible anode metals.

Chemical Equipment

Aluminum has found an important place in the petro-chemical industry. Synthetic hydrocarbons from the petroleum industry are now sources of fatty acids, and the future of aluminum processing equipment in the new synthetic organic chemical industry appears promising. The alloys are useful in storage and process tank facilities for both the raw materials and the refined products, in condensers, condenser tubing, pumps, pipe and fittings. Aluminum is one of the few common construction materials which has no catalytic prooxidative effect on oils, fats and their derivatives. Refining fats and oils by a low temperature solvent technique using propane, hexane, or furfural gives an especially high quality product whose value is maintained by processing and storing in aluminum chemical equipment.

Aluminum tank cars and shipping drums have been used for years to transport oils, fats, fatty acids and glycerine. Alloys 3S or 61S are usually used for tank car service. Alloys 2S and 3S have proven excellent for transfer lines in fatty acid installations, although 63S-T5 should be equally suitable. Process and storage tanks usually require 2S, 3S, or 52S depending on the temperature requirements. Pumps and pipe fittings of B-214, 43 or 356 are used for handling fatty acids and their derivatives.

Aluminum drums are effective for the transportation of many commodities such as oils, glacial acetic acid, gasoline, kerosene, acetaldehyde, benzaldehyde, highly concentrated nitric acid, glyceryl phosphate, methyl salicylate, paraldehyde, phenol, essential oils, acetic anhydride, formaldehyde, and butyric acid.

Aluminum has also given excellent service in refining napthenic acids. Synthetic resins, lacquers, paints, and varnishes retain their quality in such equipment.

Most of the ordinary organic solvents, either those having a neutral reaction in water solutions or those nearly insoluble in water, have no serious action on aluminum or most of its alloys. Diethyl ether, benzene, kerosene and most other ethers and hydrocarbons can be processed in aluminum.

Heat Exchanger Tubes

Aluminum tubes have been used for more than 25 years in condensers and heat exchangers. The metal and its alloys have several chemical characteristics which fit them for use in these applications. As a class they are highly resistant to oxidation and to many organic and inorganic chemicals. In addition, the tubes do not discolor, contaminate, or catalyze the decomposition of gaseous or liquid hydrocarbons.

They are particularly adaptable to the petroleum refinery service because of their high resistance to many sulfur compounds including hydrogen sulfide. Aluminum tubes have given satisfactory service in the condensing of sweet and sour hydrocarbon gases and liquids, in furfural and other types of lube oil solvent extraction processes, oil-to-oil heat exchangers, recovery of hydrocarbon solvents, steam condensers, atmospheric heat exchangers either air or water cooled, compressor intercoolers, lube oil and jacket water coolers, and numerous others. They have been used in many processes involving ammonia and carbon dioxide and have been known to give as much as 18 years continuous service in the condensing of sour gasoline.

Aluminum tubes for heat exchangers are cold-drawn and seamless, and have the desirable qualities of close dimensional control and excellent surface characteristics. They are adaptable to the accepted methods of heat exchanger construction and in the common sizes compare favorably in cost to steel and admiralty tubes.

Heat exchanger tubes are normally furnished in 3S-H14 and Alclad 3S-H14 alloy aluminum. Alloy 3S-H14 tubes have given years of excellent service where both fresh and salt water have been used for cooling. Some cooling waters, containing small amounts of heavy metal compounds such as salts of copper, tin, nickel or lead, cause pitting and perforation of 3S-H14 tubes. To combat this type of corrosion, the Alclad 3S-H14 tube was developed having an inner cladding of 72S alloy which contains approximately 1% zinc and the remainder aluminum.

This cladding, which comprises approximately 10% of the wall thickness, is metallurgically bonded to the core alloy 3S (approximately 1.2% manganese, remainder aluminum). Since the cladding material is slightly anodic to the core alloy, it galvanically protects the core from per-

Roof construction of aluminum on a 114-ft.-diameter storage tank

foration. Therefore, any pitting corrosion which does take place on the inside surface of the tube, proceeds only as far as the boundary beween the two layers. Further attack, if it does occur, takes place in the clad coating, and protection is afforded even though the coating may be consumed over a considerable area.

It is recommended that tube sheets in either Alclad 4S-F or 61S-T6 alloys be used with aluminum tubes. Where resistance to galvanic or pitting is desired, Alclad 4S-F is used. Alloy 61S-T6 is recommended where high strength is required.

In certain cases, where operating temperatures are within reasonable limits, aluminum tubes can be rolled into steel tube sheets. In some waters, such as those containing substantial concentrations of dissolved chlorides, a certain amount of galvanic attack on the aluminum may appear. It is generally desirable to use zinc anodes to limit this type of attack. Where brackish water or sea water is used for cooling, tube sheets should also be of aluminum. In no case should Muntz metal or other copper base alloy tube sheets be used with aluminum tubes.

In other applications, aluminum heat exchanger tubes can be employed in processes which use amines to separate hydrogen sulphide and carbon dioxide from hydrocarbons. Tensile properties of the alloys increase as the temperature decreases and, consequently, they can be used in tubes processing hydrocarbon liquids and gases at low temperatures. Aluminum tubes are also used in processing phenol, aliphatic acids, solvents and oils.

A recent development is the use of aluminum heat exchanger tubes in boiler air preheaters, where they have been found to be quite resistant to boiler flue gases. Their low cost makes them competitive with steel in this application.

Electrical Conductors

Aluminum is acceptable in the petroleum industry as an electrical conductor. The metal's high resistance to corrosion, especially when exposed to sulfur compounds, has made it desirable for telephone and power lines. The light weight of aluminum conductors results in easier handling, increased safety, and lower maintenance costs. In addition, it has the highest electrical conductivity of any metal on a pound-for-pound basis. Aluminum used for electrical conductors is of a high purity (99.5+%) and has a conductivity which is 61% of the International annealed copper standard.

Aluminum bus conductors have been used for over 40 years in chemical industries where corrosion attack on copper is especially severe. ACSR (Aluminum Cable Steel Reinforced) has been employed for many years, and at the present time, it is the most widely used conductor for high voltage transmission and rural distribution. Aluminum insulated wires and cables have had satisfactory service records which are comparable to those of copper conductors. These wires and cables are now being produced by several manufacturers.

Joints and connections can be made on aluminum conductors by any of the usual methods. Welding, soldering and mechanical connections are possible. Welds made by the inert gas arc welding process are convenient and require no flux. Soldering connections can be made with the torch, ladle, or soldering iron. Solder and flux are available which can be used for aluminum-to-aluminum or for aluminum-to-copper joints. Mechanical type connections and terminals have also given satisfactory service. Connections of this type should have sufficient contact area and pressure and should be used in conjunction with a suitable joint compound.

Aluminum can be found in motor rotors, spot welder arms, radio condensers, and electrical contactors.

Thermal Insulation Covering

Aluminum sheet finds use as a covering for thermal insulation on vessels, towers, tanks, and piping systems handling hot gases or liquids in petroleum refineries and petrochemical plants. Practically any common insulating material is compatible with aluminum under dry conditions. For successful application of the sheet, the insulation must be dry, or if wet, must dry quickly. Depending on the physical abuse which will be encountered, the sheet used may range from foil thickness to .032-in. and is secured either by aluminum tie wires or screws. Alloy 3S-H18 will ordinarily be used for this purpose.

Aluminum Paint

The resistance of aluminum to corrosion extends to the metal flakes in aluminum paint. The paint reflects light and radiant heat and minimizes losses from evaporation and chemical change in tanks and tank cars containing gasoline, oil products, and chemicals.

High heat aluminum paints applied to clean, rust-free, and paint-free surfaces will reduce heat losses and will not peel, flake, or discolor even when subjected to temperatures as high as 800° F. Surfaces exposed to corrosive industrial fumes and gases are effectively protected.

Aluminum paint is recommended for weather exposed metal surfaces such as corrugated siding, roofs, water towers and ladders because of its resistance to moisture and its attractive appearance. This latter quality also makes it desirable for gasoline filling stations and pumps

Field Equipment

Exploration equipment made of aluminum ranges from portable shot-hole drills to gravity-meter station platforms. Other applications in the field include shooting-truck bodies, marsh buggies, dynamite trailers, water-truck bodies, flat boats, pontoons, and geophysical instrument boxes.

Primarily because of its light weight, this material is particularly adapted for use in field equipment in inland areas where transportation is difficult because of marshlands and swamps. Aluminum shot-hole drills, for example, have been transported on pontoons, on marsh boats and by helicopter.

Aluminas

A discussion of the uses of aluminum in the petroleum industry would not be complete without some mention of activated aluminas. These are porous, granular forms of aluminum oxide (Al_2O_3). The adsorptive properties and large surface area of activated alumina make it a preferred catalyst or catalyst carrier in many petroleum and chemical reactions. In some of these reactions, active catalyst such as chromium, molybdenum, nickel, silicon, and vanadium oxides are deposited on activated alumina.

Activated alumina is one of the few compounds which will adsorb and hold moisture without change in form or properties. Commercial solvent drying units employing alumina have proved effective in the dehydration of such organic liquids as benzol, toluol, and gasoline. In the adsorbers of these units, the alumina is supported on a fine metallic screen.

Breathers for oil tanks, tank cars, and transformers employ activated alumina as the drying medium. For this application, an activated alumina containing a small percentage of cobaltous chloride may be used. This product has an indigo blue color in the activated condition and changes through pink to white as saturation is approached.

Tabular alumina is aluminum oxide which has been converted to the corundum form by calcining it at temperatures slightly below the fusion point. This product in ball form is being tested in the oil and gas industry as a heating medium in the new pebble type heater. Instead of having a stationary bed, the pebble type heater has a moving bed which is heated in one zone and is then conveyed, moved, or transferred to the reacting zone. This type of heater requires a material of good strength and high resistance to thermal and mechanical shock.

Vapor-pressure Curves for Selecting Centrifugal Gasoline Pump Sizes

By H. B. HUMMER, Allis Chalmers Mfg. Co., Norwood Works

AN INCREASING use of centrifugal rather than positive displacement pumps for the handling of petroleum products has indicated a need for information on gasoline vapor pressure applicable to such pumps.

Gasoline, so far as its pumping characteristics are concerned, is comparable to hot water. As water is heated, its tendency to vaporize or "flash" in a high lift application increases. Gasoline, on the other hand, has the same tendency but at considerably lower temperatures.

The vapor pressure of gasoline has a vital bearing on the suction conditions and lift that can be obtained with a centrifugal pump. At a specified temperature, a pure liquid exists in equilibrium with its vapor at only one pressure—its vapor pressure. A plot of this pressure against the various corresponding temperatures is known as a vapor pressure curve.

Such a true vapor pressure-temperature relationship curve for gasoline (Fig. 1) and a correction chart for calculating equivalent water suction lift when the gasoline suction lift is known (Fig. 2) will provide guidance in selecting the proper pump to meet required suction conditions. As indicated by the curves, the pressure increases as the temperature rises, while the specific gravity decreases.

The theoretical lift of a centrifugal pump when handling water at 85° F. at sea level is 32.7 ft., as shown in Fig. 3. The actual lift available is determined by the net positive suction head required, which is governed by the size and type of pump and its capacity. The net positive suction head required for gasoline is the same as that for water.

The theoretical lift available when handling summer gasoline (sp. gr., 0.72; temperature, 88° F.; vapor pressure, 8 psi.) is 21.5 ft. This is explained in Fig. 4. The correction necessary to arrive at 11.2 ft. is indicated in the calculations shown in Figs. 2 and 3.

For an example involving the use of these data, let us assume the following conditions: Required a self-priming pump rated at 60 gpm. at 80 ft. total head when handling summer gasoline; suction lift required, 10 ft. By referring to Fig. 5, a 1½ x 1½-in. pump is found satisfactory for this rating and suitable for 23

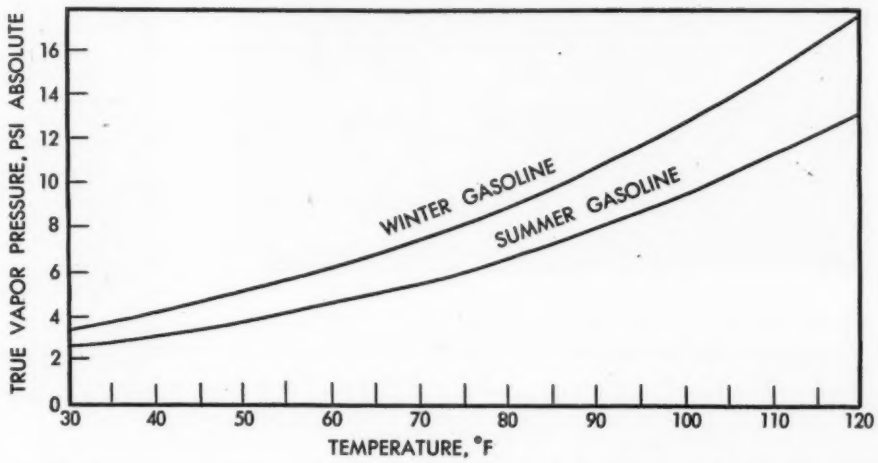


Fig. 1—True vapor pressure-temperature curves representative of average summer and winter gasoline vapor pressures. Use the true vapor pressure when it is known

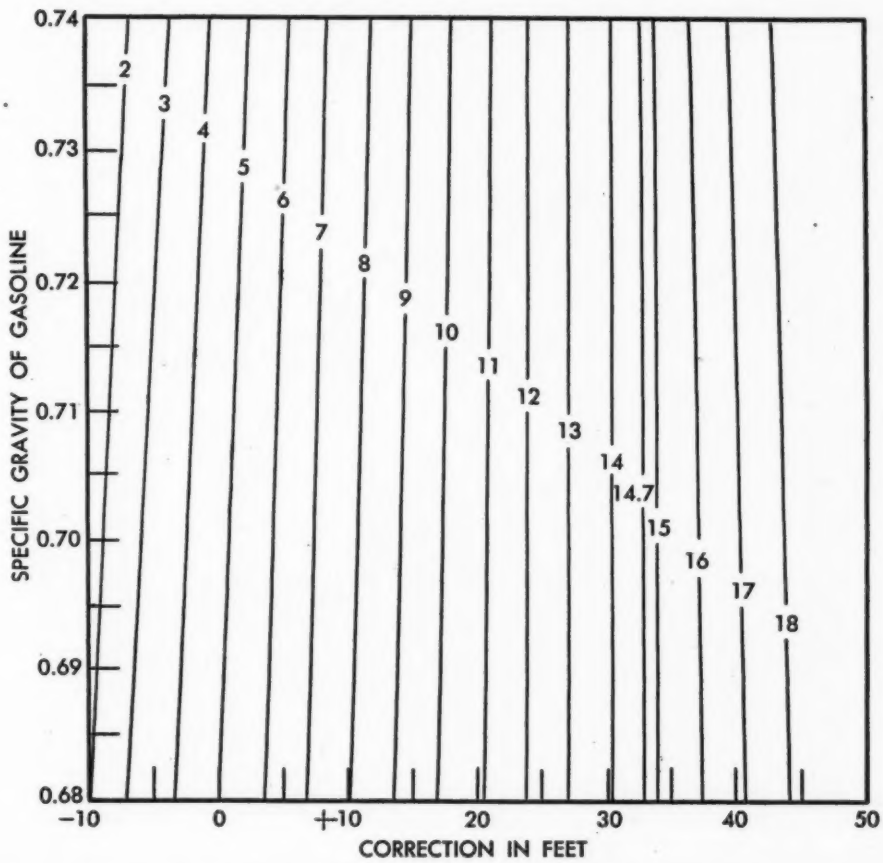


Fig. 2—Correction chart for calculating equivalent water suction lift when gasoline suction lift is known. Add correction in ft. to required gasoline lift to determine equivalent water suction lift. Numerals on curves represent vapor pressure of gasoline in psi

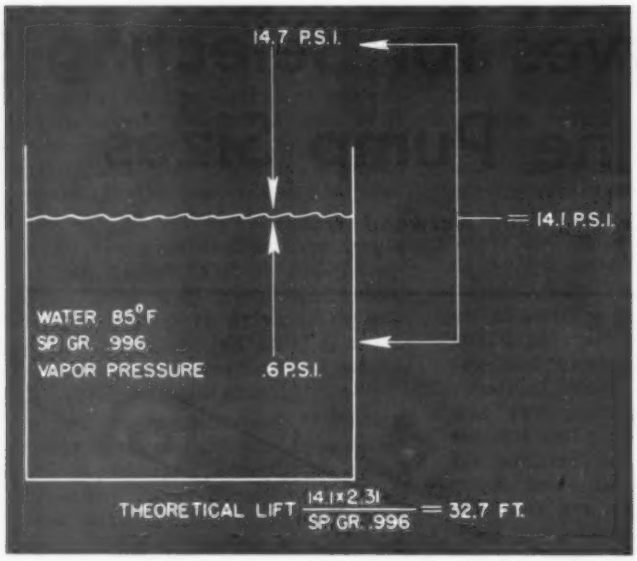


Fig. 3 (Above)—Determination of theoretical lift of a centrifugal pump handling water

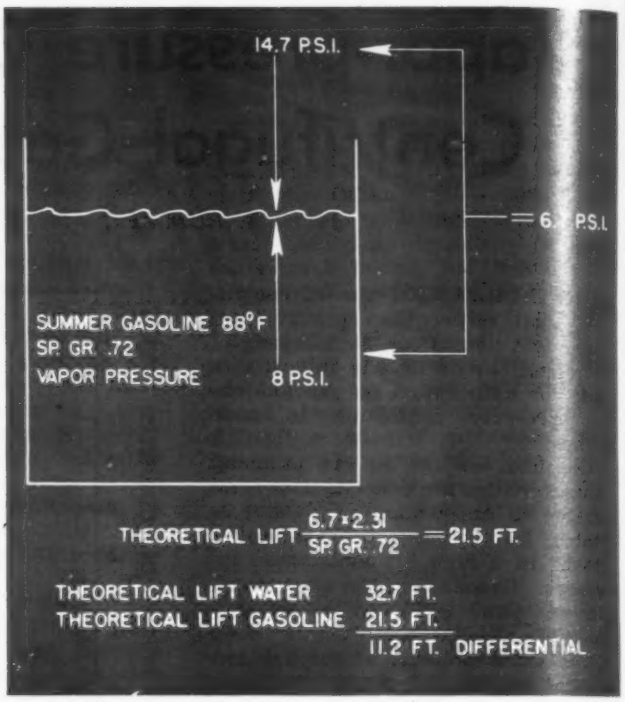

14.7 P.S.I.
= 6.7 P.S.I.
SUMMER GASOLINE 88°F
SP. GR. .72
VAPOR PRESSURE 8 P.S.I.
THEORETICAL LIFT $\frac{6.7 \times 2.31}{SP.\ GR.\ .72}$ = 21.5 FT.
THEORETICAL LIFT WATER 32.7 FT.
THEORETICAL LIFT GASOLINE 21.5 FT.
11.2 FT. DIFFERENTIAL

Fig. 4 (Right)—Determination of theoretical lift of centrifugal pump handling summer gasoline

ft. suction lift when handling water.

Referring again to the vapor pressure curve in Fig. 1, it is learned that summer gasoline has a vapor pressure of 8 psi. at 88° F. The correction chart (Fig. 2) shows that for a vapor pressure of 8 psi. when handling gasoline of sp. gr., 0.72, it is necessary to subtract 11.2 ft. from the available water lift of 23 ft. The total equivalent suction lift being 11.8 ft., or safely over the 10 ft. requirement, the 1½ x 1½-in. pump would be satisfactory.

Now let us assume the same conditions prevail except that a 13-ft. suction lift is required. From the explanation already given, it is seen that the 1½ x 1½-in. pump would not be suitable. It is necessary to select a pump, suitable for the head and capacity conditions required, with a minimum of 25 ft. suction lift available when handling water. By referring to the curves in Fig. 6, it becomes evident that a 2½ x 2½-in. pump would be needed.

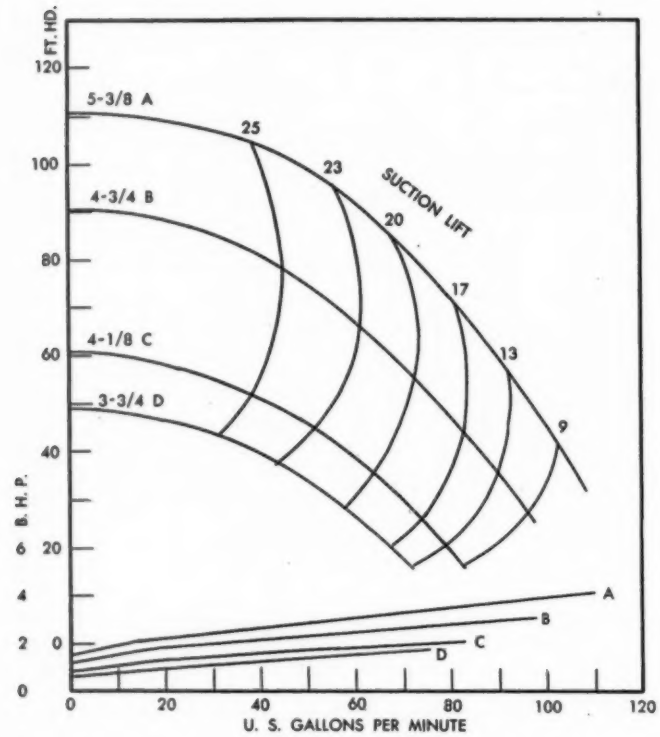


Fig. 5—Capacity curves for a 1½ x 1½-in., 3500 rpm., pump; maximum sphere size, 9/32 in.

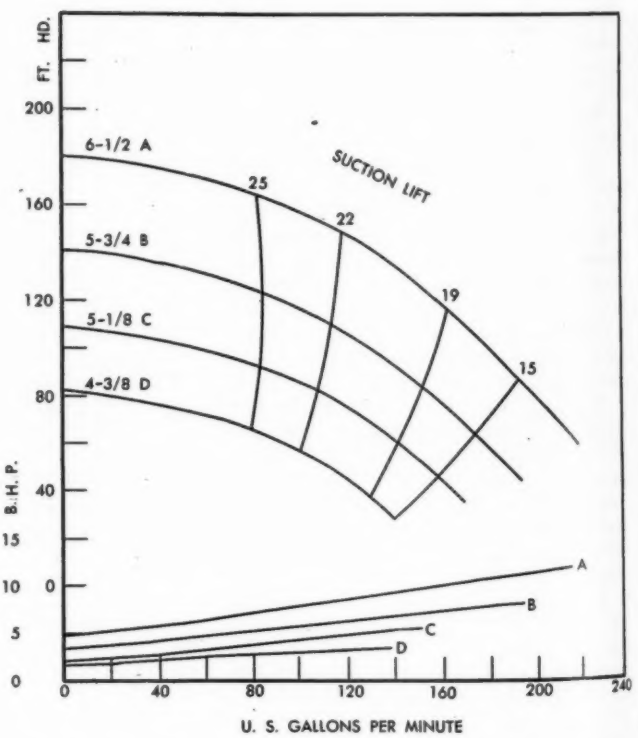


Fig. 6—Capacity curves for a 2½ x 2½-in., 3500 rpm. pump; maximum sphere size, 13/32 in.

New Lubricant Promises to Cut Costs Of Maintenance on Plug Valves

DEVELOPMENT of a new, compressible type of lubricant for pressurized plug valves is seen as a solution to the problem of leakage and high maintenance costs encountered frequently in most petroleum processing plants using this type of valve.

In contrast to the non-compressible characteristic of conventional valve lubricants, the new material is both compressible and expansible. It has physical properties that permit storage of energy for release when needed to fill a leak. Should a leak occur, the lubricant will flow automatically through the channels on the plug and interior seating surface to fill the void. The energy within the material can be built up to almost any pressure, occasionally as high as 1000 psi., but tests have shown that it will flow under a pressure as low as 50 psi. The pressure within the lubricant system is entirely independent of line pressure.

In a recent demonstration, a test valve was lubricated with the new material and then partially opened to expose the short groove through the port. This groove was scraped clean to simulate an exaggerated leak. The valve was then closed and quickly re-opened to again expose the same groove. It was found fully filled, proving the self-feeding action of the lubricant. The material has been on test for over a year in the field and on refinery lines in Pacific Coast plants.

Given the trade name, Hypermatic, the new lubricant is a development of the Nordstrom Valve Division, Rockwell Mfg. Co., in their Oakland, Calif., laboratories. It can be applied to any pressurized plug valve of the Nordstrom type presently in service, and does not require dismantling the valve to clean out the old lubricant prior to its use. Because of its energized property, it will gradually replace the old lubricant in the valve. It is injected into the valve in the same manner as any lubricant, by grease gun or by inserting in stick form. Turning of the lubricant screw imposes hydraulic force which impounds energy within the lubricant.

In regard to temperature range, for the present an upper limit of about 250 to 300° F. under some conditions has been established. It is expected that a higher temperature limit can be announced later.

Physical constituents of the product cannot at present be revealed, due to application for patents pending. In answer to the question as to whether the material is actuated by entrained gas, George F. Scherer, Nordstrom director of research who is accredited with the conception and development of Hypermatic, can only say that the explanation falls far short of actuality.

Lubrication costs on pressurized valves may be cut from 20 to 90% when the new material is used, according to Mr. Scherer. This is attributed to the fact that frequency of lubrication may be reduced to 1/10, 1/20, and even smaller ratios of the previous time.

The material will not feed into the line, although it is continually under pressure, it is stated. Nor does the lubricant pressure have to equal or exceed the line pressure. This is explained in that although the material has easy-flow properties, it resists replacement when spread out in a thin sealing film.

George F. Scherer, Nordstrom's research director, demonstrates comparative action of conventional and new lubricant in similar plug valves. After pressurization of the lines, simulated leaks are effected in each valve, and valves are closed. Valve at left contains conventional lubricant. Leak is shown by bubbles rising in beaker of water

The PROBOLOG —for Inspecting Non-Magnetic Tubing

By G. A. NELSON, Shell Development Co., San Francisco

Instances of application of the Probolog are cited to show its advantages in detecting and recording irregularities in tubes of non-magnetic metals in heat exchange equipment in refineries. The instrument also is used in studies to select suitable tube materials for specific installations. Savings in materials are realized and too-frequent shutdowns can be avoided. The Probolog was developed by the Shell Development Co.

THE Probolog is an instrument that detects and indicates or records all types of irregularities in tubes of non-magnetic metals such as are found in tubular equipment in heat exchangers, condensers and coolers. In particular, it reveals the presence of defects such as large or small holes, cracks, internal or external corrosion, erosion pits, recrystallization, non-uniformity of wall thickness, and dezincified areas. It graphically presents all of this information that is important to the maintenance and inspection groups charged with the responsibility of deciding whether to replace a costly exchanger bundle, or take a chance on having an unscheduled shutdown.

The instrument is portable and can be operated by one man. Tubes are inspected from the inside and, therefore, no special preparation of the tubular equipment is required before inspection. The tubes need only be cleaned to the extent that passage of the sensing element or probe is assured. The physical appearance of a Probolog inspecting unit is shown in Fig. 1. Its components include:

1. One or more interchangeable probes of diameters to fit standard sizes of tubing.
2. A mechanical probe puller, synchronized with the chart drive of the recorder so as to insure a precise correlation between chart recording and probe position in the tube being inspected.
3. An electronic recorder, equipped with a continuous strip chart.
4. An accessory recently added is an air gun which aids in projecting the probe to the far ends of a tube. By using the air gun, considerable time savings result and wear on the probe cord is reduced.

In its operation, the functions of the electrical components might be described as follows:

The instrument includes a probe which, when placed in non-magnetic tubing, generates a magnetic field by a pair of coils. This field penetrates the walls of the tube and induces eddy currents which, in turn, exert an influence on the coils of the probe and in effect help to determine the electrical impedance of the coils. When the probe is pulled through a *normal* piece of tubing, all the electrical characteristics are in balance, and this normality can be indicated by an electronic recorder and charted on a strip of paper as a straight line. When the material in the tube is abnormal, such as might be created by corrosion, the eddy currents are distorted and such distortions are recorded on a strip chart as deviations from a straight line.

Preparation for inspection consists merely of plugging the probe puller and probe into the recorder unit. In operation the desired sensitivity setting is selected and the instrument balanced by placing the probe in a defect-free portion of tubing and adjusting the pen-centering control of the recorder until the pen is at the center line of the strip chart. The probe is then positioned at the far end of the tube to be inspected. After engaging the probe cord between the knurled wheels, the probe puller is started, and the probe is pulled out of the tube at a uniform rate, usually 12 ft. per minute. At the same time the probe is started through the tube, the chart drive unreels the chart at a rate of 12 in. per minute. Fig. 2 shows the Probolog in operation at the head of a refinery condenser.

The resultant record drawn by the pen enables direct measurement readings as to the location of a defect in any part of the tube, as each inch of chart represents a linear foot of tubing. In addition to indicating

Fig. 1—Probolog inspection unit. In foreground, left to right, are the probe, two connecting cords and air gun, this last named a new feature of the instrument. In background are carrying case, probe puller, and recorder. The test plug, paper, ink, and standard tube are in front of the probe puller

the location and relative magnitude of individual defects, the instrument will also show, to a fair degree of accuracy, the apparent loss or gain in tube wall thickness. This indication is called "offset", since the loss or gain of metal is represented by an offset of the average position of the pen from the chart center line. The chart record can be calibrated in terms of wall thickness with an accuracy of ±5%. The accuracy is impaired, however, by corrosion conditions that introduce tube eccentricity or tapering of the tube wall.

The limitations of the Probolog relate mainly to the variety of metals that can be inspected, and interpretation of defect indications. The present instrument is designed specifically for the inspection of nonmagnetic tubes, including such metals as copper, brass, Inconel, Admiralty metal, copper-nickel, aluminum, and austenitic stainless steels. For various reasons, it is not at present adapted to the inspection of steel tubes.

Readings Require Interpretation

The manner of indicating corrosion conditions by the record is not positive, in that an inspected tube is not labeled as good or bad. Judgment as to whether a tube should be retained or discarded is a matter of proper interpretation with respect to standards which are established in the field. The standards can be instituted by splitting representative tubes which have been probed and comparing the exposed corrosion conditions with the corresponding pen deflections on the strip chart. The number and magnitude of pen deflections are then related to the severity of corrosion. In the same way, the extent of wall thinning can be related to degree of offset.

By use of this instrument, and when the information is properly evaluated, many savings have resulted. A few instances are being cited to show examples of its application.

Numerous tube bundles have been inspected and the records revealed that corrosion has been selective, being more prevalent in one part than in another. In some cases, only a portion of the bundle has been retubed while in other cases it has been possible to rotate the bundle through 180° in order to prolong the life of the remaining tubes.

Since using the Probolog it has been found that the rate of corrosion may vary considerably with the location of the tube in the bundle. This suggests that considerable study can be made for improvement in condenser design either as to flow, or the selection of proper tubular materials to be used in different parts of the same bundle. In one of our plants, experiments have been under way for the past 2½ years to select the proper tube material for a particular cooler. Tube materials under test consisted of the following metals: steel, aluminum, inhibited admiralty metal, Muntz metal, inhibited Muntz metal.

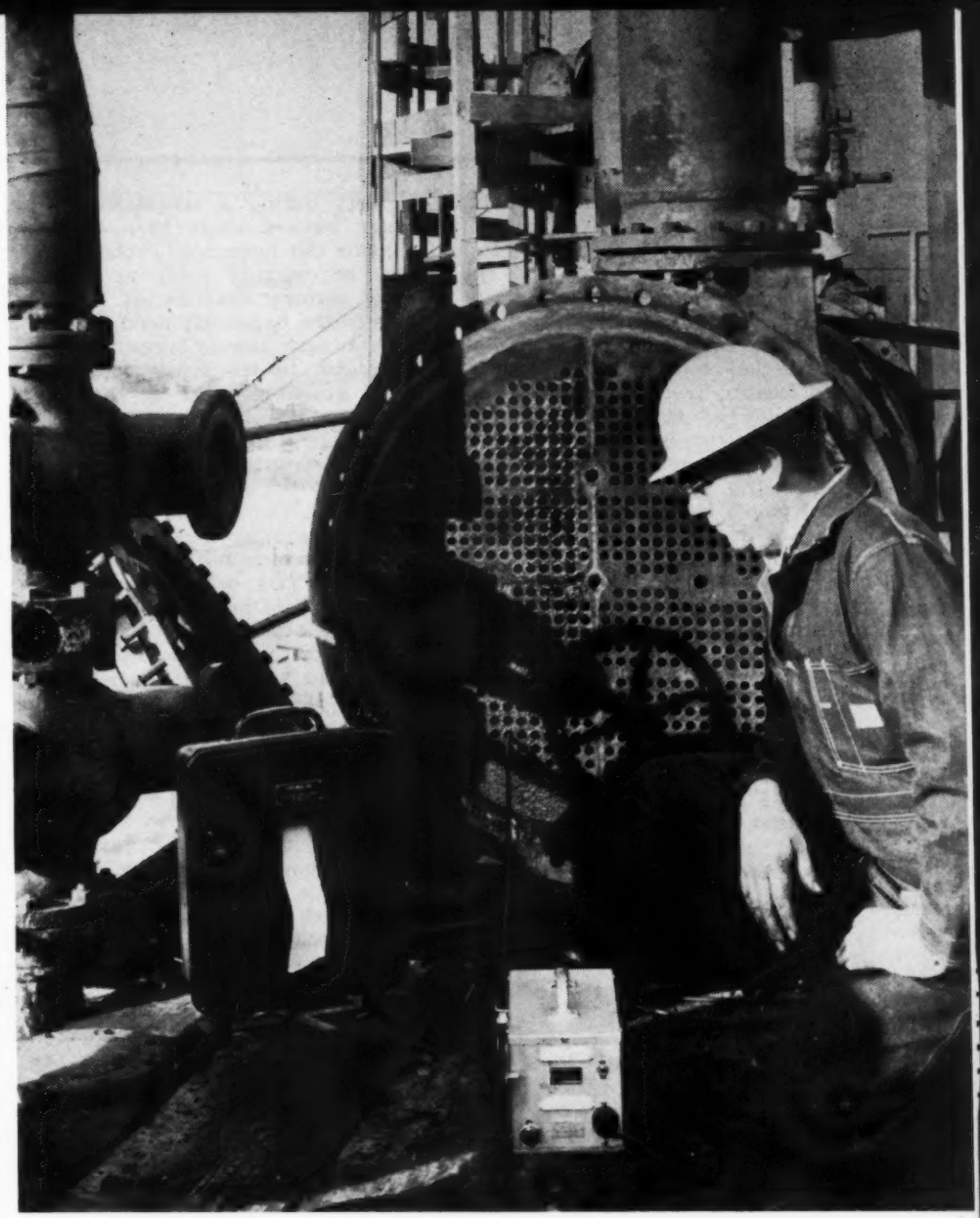


Fig. 2—Probolog in operation at the head of an oil refinery condenser

Bi-metallic tubes were also included in the series, having inhibited admiralty for the inner tube with aluminum outside in one type and inhibited Muntz metal on the outer shell in the second case. The conditions of the experiment are shown on Fig. 3. After 2½ years it was found that the corrosion was limited to the inner or water side and that steel and aluminum tubes had failed. A careful Probolog inspection was made of remaining tubes in order to select the best type of metal for replacement. The records on the charts show that:

1. Corrosion and dezincification of the tubes was much less severe on the top (cold) side than on the bottom (hot) side. Compare Muntz metal tube 150 with tube 195.

2. Inhibitors added to Muntz metal have a definite tendency to reduce damage to metal by dezincification. Compare tubes 173 and 193 both from the hot or worst side of the element.

3. Inhibited Admiralty was generally good on both hot and cold sides and compared very favorably with aluminum brass. Compare tubes 48, 208, and 226. As a result of this information from this inspection, all tubes except inhibited admiralty and aluminum brass were removed from the bundle and replaced with inhibited admiralty metal.

Fig. 4 illustrates the effects of localized corrosion in portions of tubing. The chart at the left represents the condition of tubes on the hot side of a bundle and shows only minor deflections, whereas a tube from the cold side in the same bundle is badly corroded near the tube sheet as shown by the center chart. The corrosion was found on the outside of the tube and was caused by a condensation of a corrosive fluid near

the coldest part of the element. Tubes having this type of pattern are removed from the bundle, the bad area is cut off, discarded, and the remaining good portion re-used in shorter bundles.

The two charts of Fig. 4 also demonstrate the accuracy of the Probolog in locating metal disturbances on the outside of the tubes. On the charts are noted eight evenly spaced deflections, the magnitude being approximately equal. These evenly spaced points indicate baffles on the outside of the tube and in effect represent an increase in metal thickness. The instrument is occasionally used for this purpose to log accurately the distance between baffles in an element without removing it from the shell, the cover being removed from the front end only.

Severe Dezincification

The pattern shown on the third chart of Fig. 4 indicates severe dezincification on tubing from another bundle. The metal in this tube was Muntz metal and had operated in a steam condenser about 1½ years.

Having an instrument of this type at hand, the question of using it to its best advantage continually arises. The technique varies with the particular type of operation or location of the tubular element.

On examining a bundle in an oil refinery during a shut-down period where only a short time is available to the inspector, Probolog records are usually made in a criss-cross pattern. Starting at the first tube in the upper left hand zone, one tube in each row is logged, continuing down to the lower right hand zone. Starting again at the upper right, the inspecting proceeds to the lower left with one tube in each row. This method permits a rapid evaluation of questionable zones in the bundle. These areas are then further explored by logging a number of tubes surrounding any tubes showing wide pen deflections. One or more of these bad tubes can sometimes be withdrawn from the bundle for comparison with the record charts and a decision reached as to the necessity for withdrawing the entire bundle for repairs.

On the other hand, when a bundle is known to have been leaking, the Probolog is used as a supplement to the hydrostatic test. By this method, water under high pressure is forced around the outside of the tubes while the tube bundle is still in the shell. Leaky tubes are immediately located from water coming out the ends. If a large number of tubes are leaking and are scattered over the cross-section, it can be concluded that the entire bundle is in bad condition, and no Probolog records are made. When the hydrostatic test shows only one or two leaky tubes, the Probolog can be used to good advantage. After Probologging the leaky tubes, the tube is withdrawn, split, and defects checked against the record.

Failures May Be Isolated

Subsequently, the remaining tubes in the bundle are Probologged for locating tubes which are nearing the point of failure. In certain cases, the failures may be isolated to only one pass of the bundle, and necessary repairs are made only to this portion. It has also been found that a single tube failure had been caused by the installation of a metal entirely unsuitable for the service. The Probolog showed that all adjacent tubes were in good condition, and the bundle was allowed to remain in service after plugging the hole from which the defective tube had been removed.

Files of Probolog records to follow the performance of a particular bundle are often of considerable value. These records are clipped together, and a slip identifying the bundle is attached. A drawer with separating panels about 3 in. apart is used for

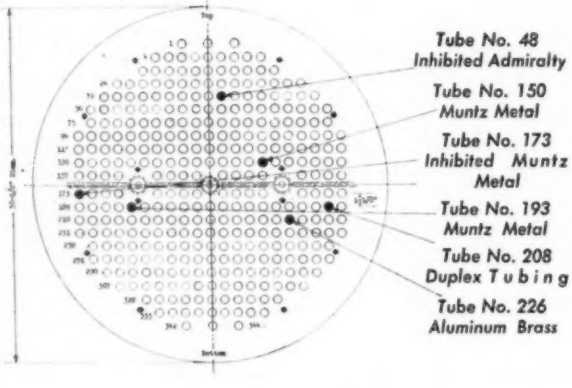
Fig. 3—Records of tubes in experimental tube bundle in a reflux condenser on a phosphate regenerator

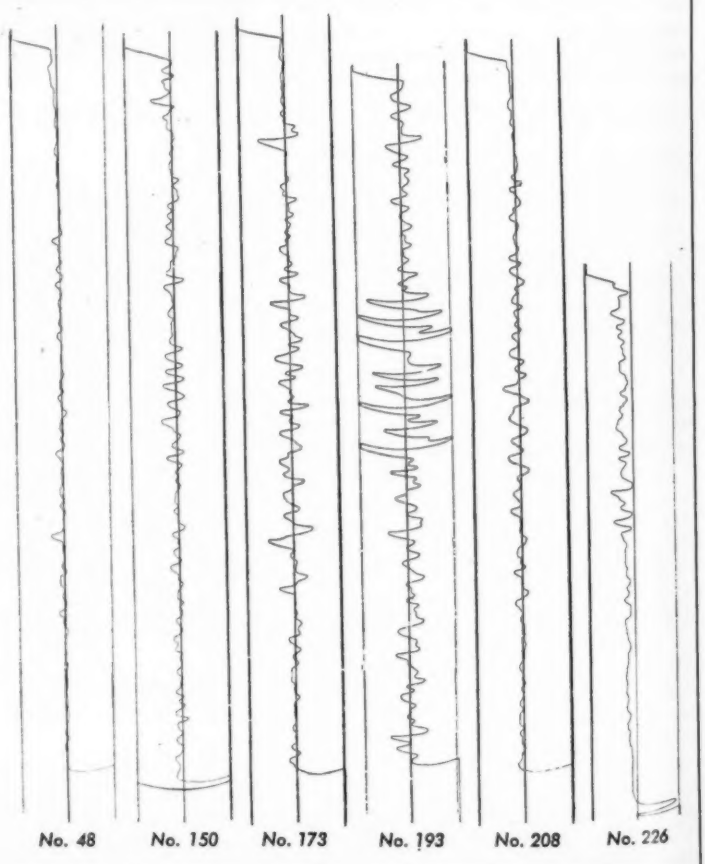
Conditions of service:
Material inside of tubes—treated well water. Temperature, 70-80° F. Material outside of tubes—Hydrogen sulfide + steam + phosphate solution. Temperature, 150-170° F. Length of test—2½ years.

Size of tubes—¾ in. O.D. by 16 gauge x 60 in.

Materials tested—steel, aluminum 3S, Muntz metal, inhibited Muntz metal, inhibited Admiralty, aluminum brass, Duplex tubes (phosphorized Admiralty inside, Muntz metal outside), aluminum Duplex tubes (phosphorized Admiralty inside, aluminum 3S outside).

Sensitivity range—5: probe speed—3 ft./min.; chart speed—9 in./min.





storing the records which are laid flat.

For the inspection of large surface condensers, such as are used in power stations, a somewhat different procedure is required. Here we find elements containing many thousands of tubes. The covers for the condensers are in some cases 3 ft. from the tube sheet. These covers have entrance manholes for use of the maintenance or inspection groups. Upon inspecting one of these condensers, all tubes directly back of the manholes are Probologged.

For checking tubes not directly back of the manhole, the operator takes the probe and probe puller in between the cover and the tube sheet. After projecting the probe to the far end of a particular tube, either by hand or aided by the air gun, the probe cord is engaged between the puller wheels. At a proper signal to the operator on the outside, the puller and recorder are started simultaneously, and the record is obtained on the recorder.

Useful in Arabian Refineries

Another phase of Probolog recording is that used by refineries, particularly in the Arabian area, where replacement tubing is difficult to obtain and very expensive. Every tube that has been withdrawn from condensers is checked by means of the Probolog to determine if there is sufficient sound metal remaining to use in a shorter element.

Sorting of mixed analyses of condenser tubes is also occasionally done. Due to the electrical property differences of the many types of condenser tube alloys, they can be separated by balancing the pen to a center line in a tube of known analysis. Then by inserting the probe into the unknown tubes of the same diameter and wall gage, all tubes with the same analysis as the standard sample will have the pen stop at the same center line. Tubes of different analyses than the standard sample will cause the pen to stop at a point removed from the center line. In order to identify the latter tubes, standards from other known materials are first established.

Saved Nearly $3900

In its first year period of operation at a Shell Oil Co. refinery, the Probolog was used to inspect 16 tube bundles. From these bundles, approximately 2750 copper alloy tubes were recovered. It was estimated that this number represented a saving of about $3900. Actually, the saving was somewhat less if the cost of inspection and cost of reconditioning tubes is included. On a basis of an estimated labor cost of $0.233 per tube the actual saving was about $3600.

The quoted labor cost of $0.233 per tube can be broken down as follows:

Labor cost for inspection $0.055 per tube.

Labor cost to remove tube $0.008 per tube.

These figures are based on expenses incurred when working with large bundles, and will vary according to bundle size and tube conditions.

At another refinery, savings of approximately $4000 were realized in three months. This figure was based on experiences with a large surface condenser at the catalytic cracking plant and a large condenser at the topping plant. It was stated that savings of from $10,000 to $15,000 per year might be expected.

The two examples just described illustrate quite well what might be called the cash savings. However, there is no way of showing how much has been saved from better operation, prevention of forced shutdowns, or prevention of accidents.

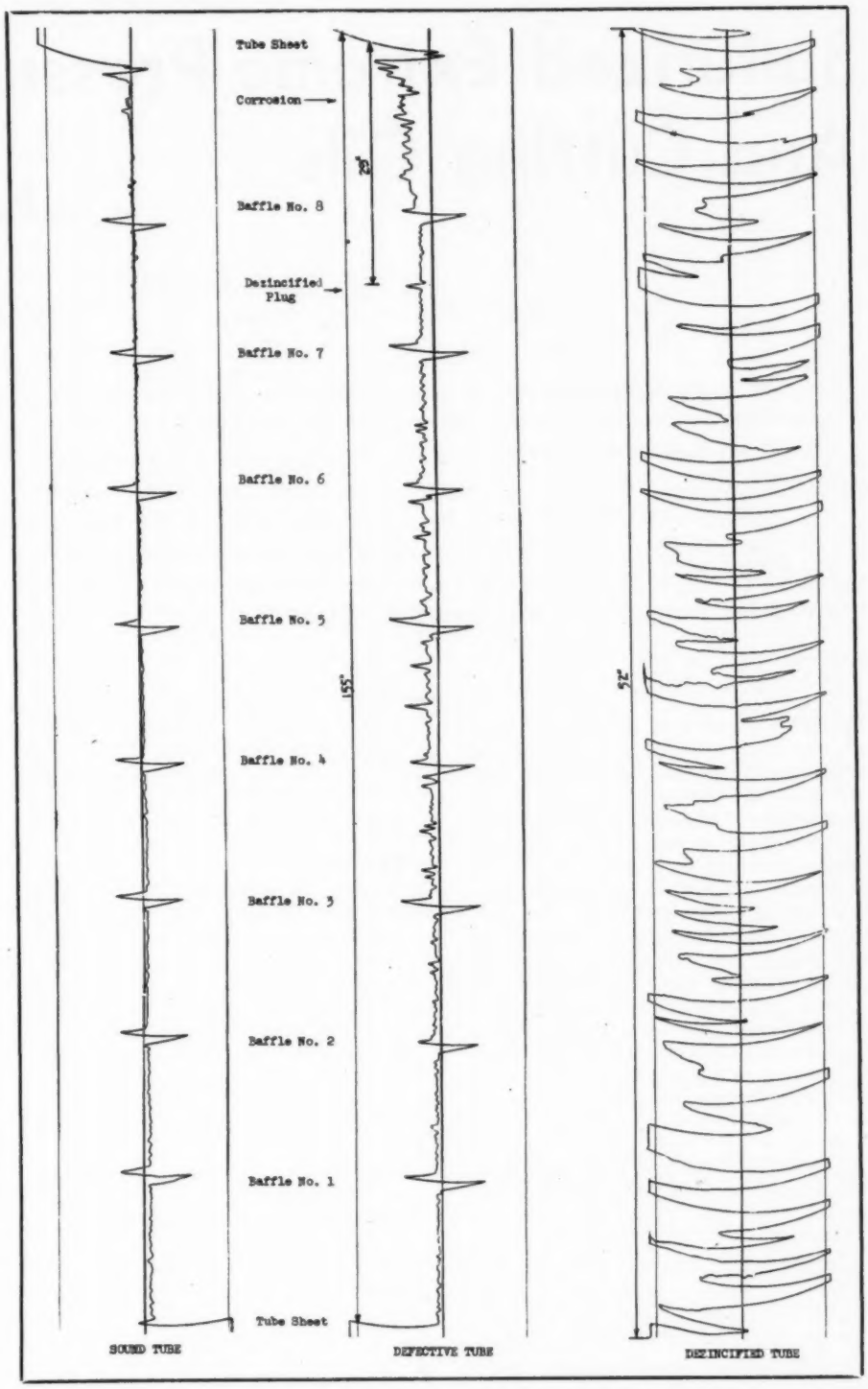


Fig. 4—Probolog records of types of corrosion encountered in brass condenser tubes

Sulfurized Extreme-Pressure Lubricants And Cutting Oils —Part 2, Patent Survey

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This paper is a survey on the general subject of sulfurized oils and sulfur compounds, with particular reference to the use of such materials in extreme pressure lubricants and cutting oils. Part 1, published in September, pp. 1003-1008, covered the important contributions published in the English language up to 1948, with a few pertinent references from the foreign literature. Part 2, printed this month, covers U. S. patents on the subject. For the benefit of readers who may not have Part 1 readily available, a summary of that portion of the paper is presented below.

Part 1—Summary

THE first part of the present survey deals with the theoretical and historical background of boundary lubrication. Boundary conditions, as known, exist where high pressure and low speed prevail. The phenomenon of friction and wear are inseparable in this region; however, functional relation has not been found between them. The laws of friction as formulated by Amontons and Coulomb—showing that friction depends on the load only and is independent of the areas involved—were interpreted somewhat differently by Bowden and co-workers. They found that friction depends on the actual contact area of two sliding surfaces, and depends on the load only insofar as the load modifies the area of actual contact, which always is only a small fraction of the apparent area of contact.

The origin of friction is attributed either to surface asperities or to strong molecular forces which cause minute welds on protruding points. The breaking of such minute welds will cause wear. For preventing the formation of welds the sliding surfaces must be separated by a thin film. Under mild pressure organic polar compounds, adsorbed on the metal by the polar group, are sufficient; under heavier load organic sulfur and chlorine compounds are used, because the inorganic constituents will form a thin inorganic sulfide or chloride film with the metal and will prevent a metal to metal contact. The mechanism of such reactions was studied in detail by Beeck, Davey, and Prutton and collaborators. Beeck and co-workers also found that organic phosphorus compounds have wear preventive action whenever they are able to form low melting eutectics with the base metal. Studies of Beeck, as well as Larsen and Perry, showed that antifriction agents, which are usually corrosive, are not wear preventing agents and rather induce wear.

The introduction of the hypoid gear in the automotive industry made the development of efficient E.P. lubricants mandatory. After careful observations of a large variety of sulfurized and other compounds by investigators like Mougey, Wolf, and Georgi, comparative E.P. tests were carried out (Prutton, Willey, McKee, Zwahl, and others) and two government specifications developed: VV-L-761 and U. S. Army 2-105.

The trend towards practical solutions are shown in the extensive patent literature covering this field from which the most pertinent sulfur compounds will be discussed in the following Part 2 of the present study.

* * *

IN the present survey only U. S. patents are included, because most foreign patents in this field have American equivalents. Summarized information from these patents is available in tabulated form, as explained at the end of this discussion. In addition to those on cutting and extreme-pressure lubricants, patents on a few other types—wherein the principal additive was obtained by a sulfurization process—are also discussed.

In the discussion of the patent literature that follows, the patents are presented chronologically so that the reader may obtain some idea of the rate of growth of the patent literature in this field. Similar contemporary patents are discussed in succession, but no further attempt was made to arrange the patents into groups according to type of product, use, or type of starting material.

Early Patents

Musgrave[63] has referred to a very early patent (22,621; Jan. 1859) by Brown, which claimed the use of sulfur in connection with a lubricant. The author, however, did not have improvement of load-carrying capacity in mind. In 1874, the addition of flowers of sulfur was recommended by Benedict (156,530) for "deodorization" of greases. Pressel, (1,367,428) in 1920, used as a coolant a combination consisting of paraffin oil, lard oil, wool fat, and sulfur.

Mineral and Fatty Oils Treated with Sulfur or Sulfur Chloride: The treatment of drying and semi-drying oils with sulfur for use in cutting oils was recommended by Bezzenberger (1,516,879) in 1924. In 1926. Becker (1,590,800) treated animal and vegetable oils with sulfur in such a manner that considerable viscosity increase was obtained with further increase being obtained by air blowing. According to Oldacre, the use of sulfur in cutting oils goes back to the early practices of blacksmiths, and in 1926 (1,604,068) he prepared a cutting oil by treating mineral oil with sulfur chloride. Chemically combined sulfur was claimed by Adams (1,824,523) in 1931, when mineral oil was treated with sulfur at 300-350° F. Nelson (1,929,955) also reacted sulfur with mineral oil, but used pressure.

First Application of Sulfur in Suspension: Abrams (1,913,300) in 1933 claimed sulfur suspended in a gel mixed with a mineral oil stabilized and bodied with a metal soap.

New Concepts, including "Non-Corrosive" Sulfur: The reaction of chlorinated wax with a polysulfide H_2S, and sulfur by Keller (1,950,850) in 1934 showed a different approach to the use of chemically combined sulfur.

Halogenated acid amides were treated with S_2Cl_2 by Henriksen and Lincoln (1,959,054) using a very short reaction time. A two-step sulfuriza-

tion was recommended by Gallsworthy (1,964,983) using sulfur and S_2Cl_2 under 50-200 lbs. pressure; the product was claimed to possess superior stability. Another patent by Gallsworthy (1,987,397) taught the sulfurization of a mixture of petroleum oil and oxidized petroleum wax. Animal and vegetable oils treated with S_2Cl_2 in two steps at different temperatures were claimed by Werder (1,971,243) in 1934.

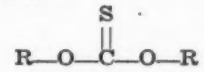
A rear-axle lubricant containing "non-corrosive" sulfur was claimed by Churchill (1,974,299) in 1934. The additive—prepared from fatty oil, vegetable oil, fish oil, or oleic acid by heating with sulfur—was claimed to be dark red and to have very little odor.

Sulfurization of Pine Oil: Pine oil was sulfurized by Edwards and Congdon (2,012,446) and, under pressure by Kaufmann (2,043,961-62). For the sulfurization of turpentine and pine oil, Borglin and Ott (2,076,875) claimed the use of H_2S under pressure, with a catalyst such as ethanolamine or aniline. Two other Borglin patents (2,111,882 and 2,125,218) deal with the sulfurization of terpenes and the refining of the product obtained. It was claimed that treatment of terpenes during or after sulfurization with alkali or with such halides of amphoteric elements as BF_3, $SnCl_4$, or S_2Cl_2, would yield light-colored products.

Sulfurized pine oil was stabilized by Merriman and Cupit (2,156,919), who passed inert gas through the product and distilled it. In this manner they removed all feebly bound sulfur.

Sulfurization of Unsaturated Compounds: The sulfurization of cottonseed oil was claimed by Adams and McNulty (2,048,479). Carter and Downing (2,061,019), using a basic catalyst, sulfurized unsaturated compounds having negative groups adjacent to the double bond with H_2S and sulfur. Utilization for cutting and drawing oils of the products from destructive distillation of acid sludge (from the acid treatment of light hydrocarbons) was patented by Cupit (2,096,449) in 1937.

Addition of Specific Sulfur Compounds: The patents discussed thus far utilized primarily direct sulfurization of mineral, animal, or vegetable oil; or the admixing of sulfur in a physical form. Since 1935, an increasing number of patents have appeared that deal with the addition of organic sulfur compounds to mineral oils and to mixtures of mineral and fatty oils. Farrington and Humphreys (2,020,021) claimed a blend containing mineral oil, or a mixture of fatty oil and mineral oil, with 1-5% of an organic thiocarbonate of the following structure:



If the thiocarbonates were not sufficiently oil soluble, higher alcohols were used as homogenizers. Aryl, alkyl, or aralkyl esters of thio acids were claimed as additives by Humphreys (2,073,841). Sodium salts of anthraquinonesulfonic acid were claimed by Cantrell and Turner (2,109,463-64).

Adams and McNulty (2,110,281) covered certain hydrocarbon sulfides and disulfides in mineral lubricating oils. The same authors covered alkyl xanthic disulfides in lubricating oils (2,206,245), and hydrocarbon thiocyanic esters and isothiocyanic esters in lubricating oils (2,209,440).

Sulfurization of Cracked Stocks: Forney (2,109,692) heated cracked petroleum polymers with H_2S and oxygen; the resulting nascent sulfur was claimed to react instantaneously with the organic polymer, and yield 20-30% of combined sulfur. A flow sheet illustrated the process comprehensively. Cracked naphtha distillate was treated with sulfur above its melting point by Muscat (2,112,677) until the naphtha attained a sulfur content of at least 15%. In a patent by Prutton (2,121,825) the polymerized olefins from cracked petroleum products, instead of being reacted with sulfur, were condensed with an aromatic compound containing sulfur in the presence of a Friedel-Crafts catalyst.

Sulfurization of Monohydric and Dihydric Esters and Alcohols: The treatment of monohydric or dihydric esters of linoleic acid with 5-20% elemental sulfur was found useful by Lincoln and Steiner (2,113,810). It was claimed that the absence of glycerine resulted in the absence of gumming and sludging. Bauer (2,116,182) found charcoal and zirconium dioxide to be suitable catalysts for mercaptan formation from long-chain aliphatic alcohols and H_2S.

Use of Lead Soap: To improve load carrying properties, the use of lead soap was recommended by Karns (2,121,151) in the sulfurization of a slightly oxidized mineral-oil base. Sulfurized pine or lard oil containing corrosive sulfur was blended with lead naphthenate and a high-V.I. oil by Miller (2,136,391).

Sulfurization of Chlorinated Products: Turner (2,124,598) claimed a sulfochlorinated gear-lubricant additive produced from a chlorinated wax or mineral oil by reaction with an alkali polysulfide or H_2S. The final product, which contained both sulfur and chlorine, was claimed to have good color and 13-22% combined sulfur. A later patent by Turner (2,192,700) utilized similar methods.

Sulfurization of Aliphatic Nitriles: Sulfurized aliphatic nitrogen compounds were claimed in several patents assigned to Armour and Company. For example, Ralston (2,141,142) claimed the reaction products of aliphatic nitriles with S_2Cl_2 or with S_2Cl_2 and sulfur. The reaction of aliphatic nitriles with H_2S and sulfur was also claimed by Ralston (2,168,848.)

Sulfurization of Viscous Oils: Parkhurst (2,142,916) found sulfurization of high-viscosity mineral oils in an inert atmosphere to be advantageous; the product was freed from excess sulfur with solvent treatment.

Physically Admixed Sulfur: Sulfur was admixed physically without any chemical action by several inventors, using procedures similar to that mentioned in an earlier patent by Abrams (1,913,300). In a subsequent patent (2,157,379) Abrams claimed finely divided sulfur in castor oil or in sulfonated castor oil. Buxbaum (2,151,585) applied colloidal sulfur suspended in a paste. Steiner in a somewhat later patent (2,228,219) claimed suspension of sulfur in alkylated or chlorinated naphthalene and blending of this material into mineral oil. The use of sulfur solutions in halogenated alkylated solvents was also recommended by Steiner (2,233,436). In a later patent by Burk (2,290,032) iron sulfide was dispersed in mineral oil. Because of the absence of chemical reaction requiring high temperatures, most of the admixed products have a very light color.

Use of Rubber Accelerators: It was claimed in several patents that the reaction time and temperature can be reduced considerably through the application of rubber accelerators. Gottesman (2,152,185) claimed sulfurized drying oils primarily as a rubber substitute, but stated that it might be used for any other purposes where sulfur accumulated at double bonds is useful. Ammonia, aromatic and aliphatic amines, and substituted guanidines were included among the accelerators recommended for the H_2S-and-sulfur treatment of such unsaturated fatty acids as rapeseed oil and castor oil. Substituted aniline and guanidine, as well as such amino-sulfur compounds as diphenyl thiourea and diorthotolyl thiourea, were claimed by Bennett (2,206,151-52) to act as accelerators for the sulfurization of mineral oil and fatty oils.

Increasing Efficiency by Combining Additives: The extreme-pressure

properties of halogen-bearing compounds were found by Prutton (2,153,482) to be greatly enhanced by the addition of dibenzyl disulfide. Another patent claiming a blend of chlorinated aliphatic compounds with sulfur-bearing organic compounds was one of Lincoln and Steiner (2,178,534). A large number of inventors have claimed that a relatively high sulfur content in a molecule increases the efficiency of a lubricant. Lincoln (2,154,626 and 2,154,628) claimed the use of dialkylpolysulfides containing dissolved free sulfur. Lanolin, charcoal, and metallic soaps may be added as thickening agents. Alkyl esters of alkyl xanthic acids were claimed by Fuller (2,161,566).

The reaction products of alkali xanthates and thiocarbonates with Chlorex-type compounds were claimed by Moran and Fuller (2,161,584). Alkali xanthates were prepared according to known reactions and were further reacted as follows:

$$2ROSCSK + (ClC_2H_4)_2O \rightarrow (ROSCSC_2H_4)_2O + 2KCl$$

to obtain dialkyl xanthyl ethers. These products were claimed to have excellent E.P. properties when blended in concentrations of about 2% with mineral oil. Dichlorophenylmethyl polysulfides were claimed by Babock and Loverde (2,185,009).

Further Specific Sulfur Compounds: Evans (2,164,393) recommended the addition of aromatic thioethers with substituted ester groups. Methylsalicylate derivatives such as bis(3-carbomethoxy, 4-hydroxyphenyl) thioether were particularly claimed. These are formed by the reaction of methyl salicylate and sulfur chloride. Amounts as low as 0.5% were claimed to be very effective E.P. agents. Evans obtained some further patents along these lines; these will be discussed in their chronological order. Thiocyanates and isothiocyanates containing aryl or alkyl groups were claimed by Loane and Shoemaker (2,169,700).

Sulfurization of Naphthalene and Petroleum Derivatives: Kaufman (2,167,612) sulfurized naphthenic acid and its derivatives with sulfur under pressure of 50-100 lbs. Sulfurized naphthalene was claimed by Hendrey (2,147,578). Light-colored compounds made of sulfurization of dihydronaphthalene derivatives were claimed by LaFrone Magill (2,176,632, 2,202,501-02). Kobbe (2,178,325) sulfurized hydrocarbon gums or resins, such as the polymerized product obtained from dihydronaphthalene and designated RH-35. Corkery (2,193,476) heated cumarone-indene resins and aromatic still residues with sulfur at 340° F. Polymerized unsaturated hydrocarbons from cracked extract were sulfurized by Chittick (2,181,964).

Sulfurization of Oils from Wood: Sulfurized products obtained from wood such as wood acids (tall oil), pine oil, pine-oil derivatives, and monohydric-alcohol esters were claimed in a number of patents. Lincoln and Steiner (2,172,285) described a process for tall-oil sulfurization. Synthetic monohydric- and dihydric-alcohol esters—such as methyl oleate and ethyl abiate—were treated with sulfur or sulfur chloride (2,186,646); the sulfur content of the product was about 27%. The mono- or dihydric-alcohol esters of tall oil were sulfurized by the same authors (2,204,538). Pollak and Hastings (2,198,562) sulfurized tall oil under carefully controlled conditions to get minimum sludging.

Sulfurized Monoesters of Fatty Acids: The use of sulfurized unsaturated fatty-acid monoesters, particularly sulfurized sperm oil, was claimed in a series of patents by Smith and by Smith and Cantrell (2,179,060-66). These patents gave a complete description of the manufacturing process involved. The amount of sulfur applied was sufficient to saturate the double bond. Sulfur chloride was recommended for obtaining sulfochlorinated products that contain 2-6% sulfur and 2-7% chlorine. By-products were removed with acid-washed clay. In one variation of this process, the sulfurized oil was treated with acid and contacted with clay before neutralization. Blending of the sulfurized refined sperm oil with tricresylphosphate and chlorinated paraffin was also recommended (2,179,067). In a considerably later patent (2,360,904) unsaturated glycerides were sulfurized and subjected to alcoholysis by Smith in order to obtain sulfurized monohydric-alcohol esters.

Miscellaneous Sulfurization Materials: A variety of sulfurizing agents and materials to be sulfurized can be found in the patent literature. Diarylamines were treated with sulfur in the presence of catalysts of the $AlCl_3$ type by Cantrell and Turner (2,190,648) to obtain products containing 12-15% sulfur. Badertscher, Berger, and Seger (2,197,781) sulfurized unsaturated organic material with perchloromethyl mercaptan. Condensation of tricresylphosphite with sulfur at about 370° F. was recommended by Engelke (2,260,303-05).

Semi-drying oils partially polymerized with sulfur were sulfurized by Wasson (2,195,549). Burk (2,201,607) claimed to incorporate 40-50% sulfur into mercaptans without the formation of insolubles by applying a method of selective solvents. Whittier, Williams, and Moir (2,211,306 and 2,420,280) sulfurized lard oil in mineral oil with S_2Cl_2 and sulfur and obtained a non-corrosive compound by phosphorizing the already sulfurized base. The admixture of organic phosphoric-acid esters with sulfurized mineral oil was found useful in cutting oils by Morway and Zimmer (2,252,133). Reaction products of S_2Cl_2 with phosphorus or inorganic phosphorus compounds were applied by Whittier (2,268,232) as sulfurizing agents for fatty oils, such as lard oil. Similar chemicals were used by Williams (2,274,022) to make an efficient E.P. agent from lard oil.

Two-Step Sulfurization for Light Color: Zimmer (2,222,643) claimed two-step sulfurization processes in which a base—such as a lube extract—was first sulfurized and then blended with mineral oil; the blend was then further sulfurized. Terpene or olefin polymers were similarly sulfurized (2,246,282). Zimmer and Morway (2,246,281) also claimed a two-step process for the sulfurization of lard oil—preferably mixed with mineral oil—in which the material was treated first with S_2Cl_2 at temperatures not exceeding 250° F., and then with sulfur at around 300° F. Stable light-colored products were claimed to have been obtained. The sulfur incorporated in the second step was non-corrosive and was claimed to improve load-carrying considerably.

Sulfurization of Sulfur Compounds: Sulfurization of mercaptans obtained from petroleum with S_2Cl_2 and sulfur to form polysulfides was claimed by Mikeska and Miller (2,205,858). Alkyl mercaptans together with olefin dihalides were treated with alkali polysulfides by Voorhees (2,257,290).

Nitrogen-Sulfur Compounds, Thioketones: Mercaptobenzothiazole and thiuramsulfide were found to be E.P. additives by Busse (2,201,258), who limited his invention to oil-soluble compounds containing at least one carbon atom to which nitrogen and sulfur were directly attached. Thiobenzophenone—obtained from benzophenone dichloride with sodium hydrosulfide—was found to improve the film strength of lubricants by Cantelo (2,204,660). Reaction products of amines and CS_2 were treated with sulfur by Musselman and Lankelma (2,251,686). Sulfurized aldehyde amines were claimed by Cook (2,290,316).

Sulfur-Halogen Compounds as Additives: Lincoln, Henriksen, and Steiner recommended a large variety of compounds which were claimed to impart E.P. qualities to lubricating oils, and which also could be used in cutting oils: halogenated thioethers and chlorofurfuryl thioethers were claimed in one patent (2,213,988),

and halogenated phthalic acid plus open- or closed-chain derivatives containing sulfurized products in another (2,251,738). Morway and Zimmer (2,217,764) claimed the sulfur chloride derivatives of abietic acid esters.

Improved Color and Reduced Sludging: Sulfurization of unsaturated fatty alcohols—such as oleyl alcohol and sperm alcohol—yielded clear products without sludge or sediment, according to Segessmann (2,254,756). Lincoln and Byrkit (2,264,319) blended sulfurized compounds—such as sulfurized esters, pine oil, or petroleum residues—with chlorinated foots oil. Products having exceptionally good color were claimed by Knowles and McCoy (2,289,437) and by Knowles, McCoy, and Patterson (2,417,305). In the first of these patents, aliphatic compounds with one or more unsaturated linkage—such as oleic acid or peanut oil—were sulfurized with sulfur under H_2S pressure in the presence of water, and the sulfurized products were separated from the water layer by a selective solvent. In the latter patent, terpinolene was treated with sulfur in a stainless-steel autoclave under moderate pressure (50 lbs.) and reacted with an alkali sulfide; the product contained approximately 30% sulfur.

Other Organic Chemicals and Refinery By-Products as Additives: Diaryl alkyl disulfides were used by Kimball (2,273,471). Organo-metallic and quaternary ammonium salts containing sulfur were claimed by Lincoln and Byrkit (2,257,750-52). The use of thiourea and similar compounds with chlorobenzoic acid was claimed by Prutton (2,298,637-39). Chlorinated acid sludge (from naphtha) treated with sodium butyl mercaptide gave satisfactory E.P. lubricants, according to Armendt (2,305,401). A further patent by Zimmer and McNulty (2,311,500) claimed the use of chlorinated solvent extracts in a similar way. The high sulfur content of thioketopolysulfides made the use of small quantities possible for satisfactory E.P. lubricants, as shown by Shoemaker (2,307,307). Cook and Thomas (2,311,931) also recommended only small quantities of a barium alkyl salicylate with a polysulfide group.

Sulfurization Conditions vs. Corrosiveness: Potter (2,246,415) stressed the importance of reaction time in the sulfur treatment of pine oil. Insufficient reaction time resulted in corrosive sulfur, whereas an unduly lengthy reaction time induced sludging. Palm oil obtained from the Vinifera palm was treated with sulfur at high temperatures and optionally with P_4S_3 by Roehner and Sudholz (2,308,427) to yield an E.P. lubricant; the nature of the sulfur in the compound was determined by the conditions of sulfurization, lower temperatures and smaller amounts of sulfur producing the non-corrosive type.

Sulfurization of Olefin Polymers: Treatment of chlorinated isobutylene polymers was described by Hull (2,259,695). Isobutylene polymers were treated by Morway (2,291,404) with S_2Cl_2 or SCl_2, in the presence of PbO or ZnO as an accelerator. Cohen (2,312,750) obtained mild E.P. agents with low sulfur content by treating mono-olefin polymers—such as polyisobutylene—with sulfur or a sulfur halide. Olefin polymer resins, made preferably from isobutylene and butane in the presence of BF_3 at −80° F., were treated with 1-25% sulfur by Anderson (2,330,858) to yield products with good E.P. properties.

Sulfurization by Nascent Sulfur: Such organic substances as pine oil, sperm oil, paraffin oil, or naphthenic acids were sulfurized with liquid sulfur halides in the presence of ammonia by Abramovitz and Beach (2,313,611). The nascent sulfur set free by the reaction of ammonia with sulfur chloride—according to the equation: $16NH_3 + 6S_2Cl_2 \rightarrow 12NH_4Cl + S_4N_4 + 8S$—immediately reacted with the organic substance to yield a product light in color and free from obnoxious odors.

P_2S_5 Treatment: Loane and Gaynor (2,316,081-82; 2,316,087-88) treated hydrocarbons with P_2S_5 to obtain motor-oil additives. The treated hydrocarbons could be paraffins, olefins, aromatics, olefin polymers and condensation products of olefins and aromatics. Kelso and Mixon (2,316,090) added small amounts of free sulfur to compounds given in the Loane-Gaynor patents—in particular to an oil containing a neutralized phosphorus sulfide-isobutylene polymer reaction product—to improve bearing corrosion. The free sulfur could be obtained also from an organic sulfur compound yielding sulfur; for example, a sulfurized mineral oil. Lincoln and Steiner (2,357,211) treated unsaturated organic-acid esters with P_2S_5. Mineral oil was sulfurized by Hughes (2,386,952) with P_2S_5, and the residual P_2S_5 was taken up with small amounts of a fatty oil like soybean oil, corn oil, or degras; cottonseed oil could also be used, and small amounts of dioctylester of sodium succinic acid and lead naphthenate could be added (2,398,429).

Combined Processes: Acid amides were treated with sulfur or sulfur chloride by Whittier and Stucker (2,348,044) and the product was further treated with phosphorus. Treatment of Stoddard Solvent with sulfur, H_2S, an alkali sulfide, and S_2Cl_2 at 350° F. under pressure yielded an oil additive, according to Lincoln, Byrkit and Steiner (2,348,080). Patterson and McCleary (2,361,051) claimed the oil-soluble metal salts of sulfurized, partially halogenated cardanol. Chlorinated aliphatic materials in which the chlorine is partially substituted by a thiocarbonate group were claimed as E.P. agents by Story and Seger (2,331,005). Metallic compounds containing halogen and sulfur in the organic radical were claimed by Lincoln (2,334,566). Very high film strength was attributed by Osborne (2,343,831) to combinations containing reaction products of chlorine compounds with dialkyl-dithiophosphoric acid salts. Lard oil and sperm oil, sulfurized at two different temperatures (190 and 250-300° F.) and further reacted with phosphorus or phosphorus compounds, were claimed to be excellent E.P. agents by Whittier and Stucker (2,352,818). Stucker (2,382,115) blended organic polysulfides and sulfurized phosphorized fats into mineral oil to form E.P. additives. Whittier (2,382,121) treated lard oil, dissolved in mineral oil, with sulfur and sulfur chloride in a nitrogen or H_2S atmosphere.

The use of "promoters" in mineral-oil sulfurization was patented by Smith (2,378,803), who claimed that substantially lower temperatures could be applied if the sulfurization were carried out in the presence of such promoters as sulfuric, phosphoric, or sulfonic acids. The resulting sulfurized oils were said to have a light color. Excellent results were reported with acid-treated mineral oils which were sulfurized after separation from the acid sludge but before neutralization. Oil-soluble sulfurized nitriles of fatty and rosin acids were patented by Jolly (2,380,531).

Efficiency and Light Color: Dark-colored by-products were eliminated by the use of sulfur-bearing organic compounds, according to a number of patents. Dixanthyl-dialkyl-thioethers were claimed by Cook (2,323,797) as E.P. agents. Blake and Godfrey (2,381,483) added trichlorobenzylethylxanthate to mineral oil to obtain an E.P. agent. Blake (2,396,487; 2,422,769) also recommended trichlorobenzylbutyl trithiocarbonate and similar products. Evans and Elliott (2,388,047) claimed the use of polysulfides of two aromatic radicals each of which contained a hydroxyl and a substituted ester group, as recommended in an earlier patent by Evans (2,164,393); the di-, tri-, or tetrasulfides of methyl salicylate are examples. Phosphite and thiophosphite esters of similar structure were covered by Evans and Elliott (2,396,839).

Recent Developments: The variety

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of products recommended for increasing the E.P. qualities of lubricating oils is ever increasing. Sulfur is still one of the most essential ingredients, but other components cannot be neglected. The following patents show the principal trends since 1946:

Sulfochlorinated products were obtained by Yule (2,394,734) by sulfurizing heptachloropropane and lard oil in mineral oil with S_2Cl_2 in two steps. Rogers and Wallace (2,396,345) claimed lecithin and similar products as stabilizers for sulfurized mineral oil, and added small amounts of triethanolamine to improve odor. Halogenated xylene was reacted with a sulfur-bearing reagent by Prutton (2,396,233), and was blended with a mineral oil.

Zimmer and Morway (2,398,271) treated polymers, obtained from cracked gasoline, with sulfur or S_2Cl_2. Sulfurized naphthalene was reduced under considerable pressure (1500 lbs.) to thionaphthols by Lazier, Signaigo, and Wise (2,402,645). Fatty-acid esters of monohydric alcohols were treated with P_2S_5 by Musselman (2,399,243); the sulfur of the P_2S_5 being stoichiometrically equivalent to the oxygen in the ester. Patterson (2,403,234) claimed sulfurized cardanol as an oxidation inhibitor. Culmer (2,412,131) claimed that lecithin prevents active sulfur from causing stains in sulfurized sperm-oil bases. In a preservative-type oil, Swartz (2,412,633) claimed sulfurized terpenes as corrosion inhibitors.

A patent by Prutton (2,417,087) listed a large variety of additives claimed to be successful E.P. agents; these were alkylated cyclic compounds with side chains containing sulfur in the form of mercaptan, sulfide, polysulfide, thiocyanate, thioketone, thioaldehyde, thiocarboxyl, or thioester groups.

Starting with olefins, Schultze and Crouch (2,415,851) prepared mercaptans with H_2S and transformed them into disulfides under high pressure. Musselman (2,422,206; 2,422,630) claimed ester-type waxes—such as degras or lanolin—treated with P_2S_5 as lubricating-oil additives. Derivatives such as Ca, Ba, Al, and amine soaps were listed in the examples. Yule and Moir (2,420,280) treated sulfurized fats with phosphorus sesquisulfide and sulfur. Winning and Rogers (2,422,275) stabilized sulfurized diisobutylenes and similar products with phenolic compounds; the patent contains a complete description of this procedure. Rogers, Watson, and Starrett (2,422,585) used sulfurized terpenes, together with olefin derivatives treated with phosphorus sulfide, as additives for lubricating oils.

In a recent patent (2,433,853) Lincoln and Steiner claimed to overcome all the failings of cutting oils of the sulfurized lard-oil type by substituting monohydric or dihydric phenol esters of unsaturated acids for lard oil, and treating them with either sulfur, sulfur chloride, or a phosphorus derivative. Time and temperature were stated to be important factors in determining the nature of the sulfur in the compound; short reaction time and low temperatures favor "active" sulfur formation.

During the past few years, requirements of E.P. lubricants have changed considerably. The present trend in patents is toward compositions having high film strength, good color, stability in storage, and non-corrosiveness to copper and other non-ferrous metals.

Patent Summary

Because of space limitations, the tabulated summary of over 200 patents covered in this survey is not being published in PETROLEUM PROCESSING. Single copies of it are available to readers without charge, however, upon request to:

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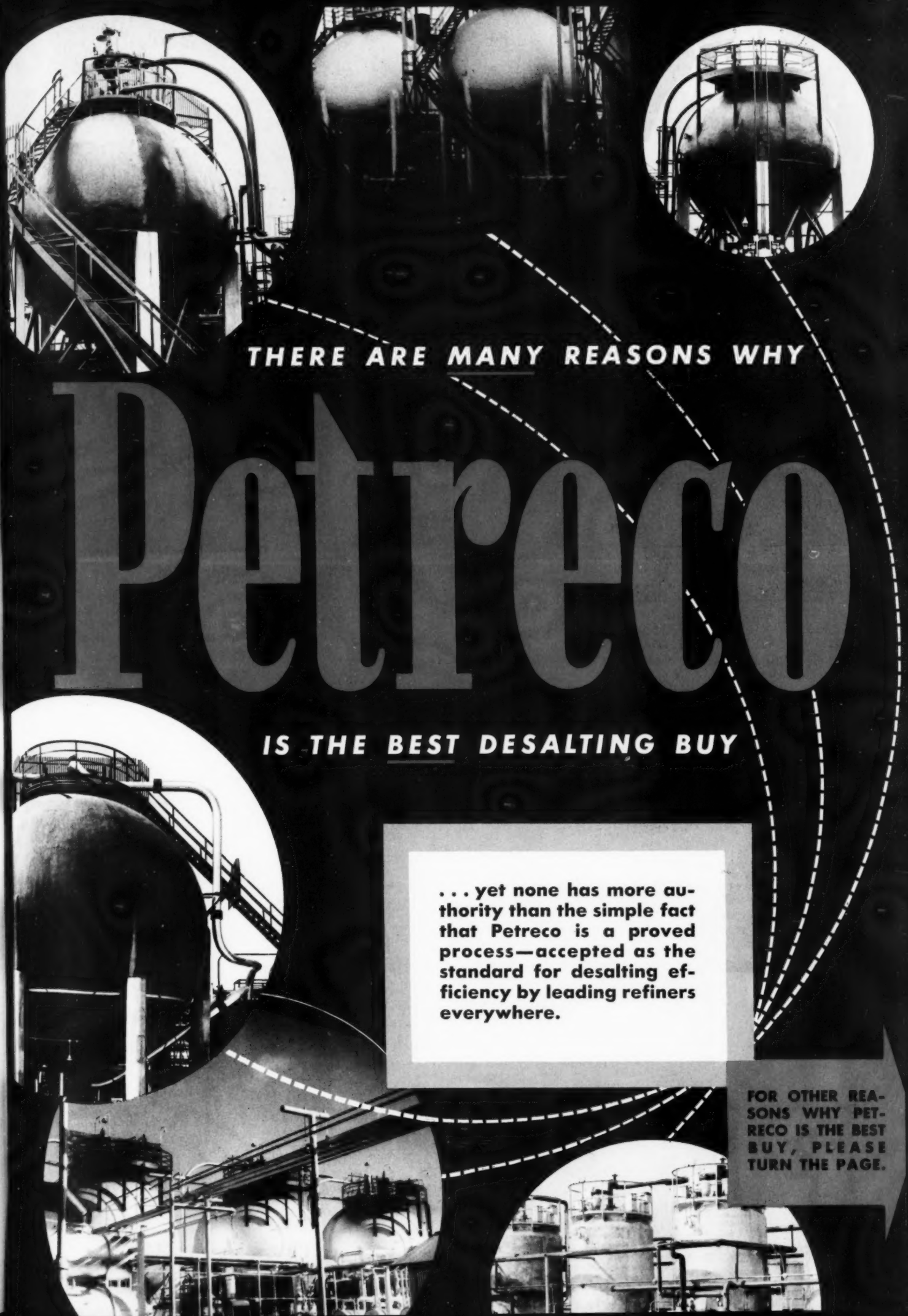
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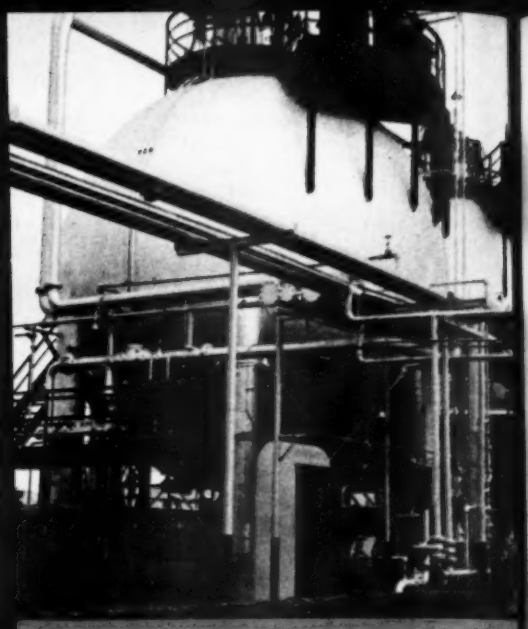

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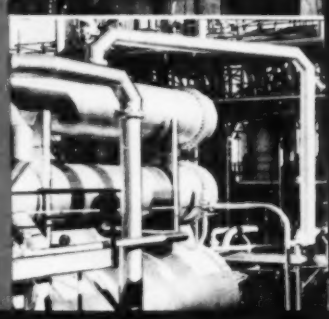
Reduced corrosion in overhead equipment.		*Less shut-downs due to mechanical failures.*
Less plugging in exchangers.		*Lower clean-out costs, more efficient heat exchange, longer runs.*



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Plant Practices

Practical Tips and Ideas for Improving Operations

Weld Repair Jobs on Castings Are Easy When Electricity Is Used for Preheat

REPAIRS on large and intricate iron castings by welding would be a comparatively simple task were it not necessary to preheat and cool carefully to avoid stresses which might cause further major cracks and damage.

Conventional practice is to preheat the casting in a charcoal fire to the desired preheat temperature—as high as 1100° F. in the case of a cast iron housing for a large centrifugal compressor. The welding operation following this treatment always is an uncomfortable and thoroughly-disliked job for the welder.

A method developed and in use by the maintenance shop in the Philadelphia refinery of the Gulf Oil Corp. utilizes electrical resistance-wire heating coils and an asbestos blanket to obtain precise and uniform heating and cooling, as well as to eliminate the discomfort to the welder. It is illustrated in the accompanying photographs. Work is done on a 10 x 14 ft. "table", or hearth, placed in any convenient location in the shop. The table comprises a rectangular frame of steel I-beams, supported on a few 4-in. I-beams to provide air space between it and the shop floor. The table top proper is made of a bed of fire brick.

When a job is to be done, the iron casting is placed on the hearth, and then is wound spirally with the resistance wire coils. A number of thermocouples are spot welded to its surface at strategic or critical points. It is then covered completely with a plastic mix of asbestos insulation.

The thermocouples are hooked up to a potentiometric multiple recorder. The resistance wires are connected to a set of 300-amp. welding machines, and the current is turned on. As many as four machines may be required to bring the casting up to heat, and perhaps half of them are needed to hold the temperature, which is checked carefully for uniformity by means of the recording instrument.

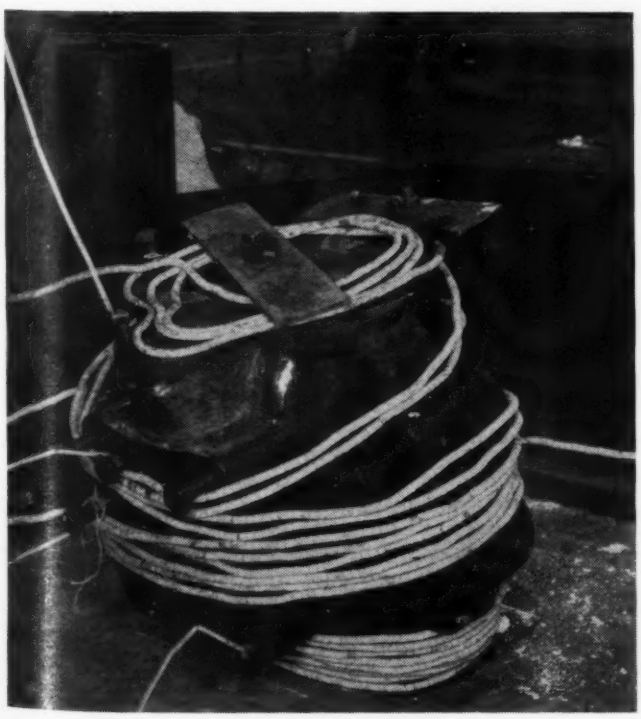
When proper temperature has been reached, the insulation covering the section to be repaired is removed. The welder can make his repairs in complete comfort. The repaired point is then re-covered with insulation, and the casting is allowed to cool at the rate of about 50° F./hr. Gulf has found this electrical method reduces post-welding to a very small amount, takes very little longer than the use of charcoal, and is much easier to use.

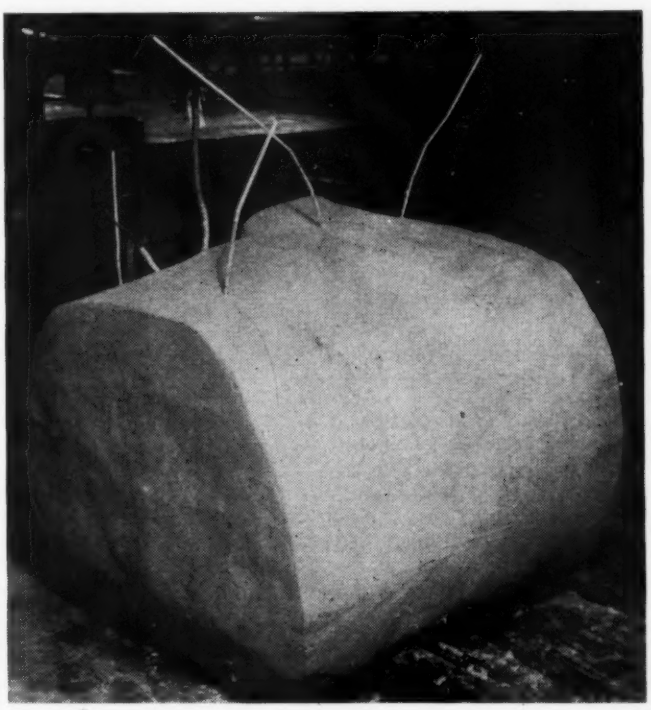
Photograph at left, below, shows resistance-wire wrapped around castings and several thermocouple connections. Photo at right shows insulation covered casting, ready for preheat. Several thermocouple leads are visible

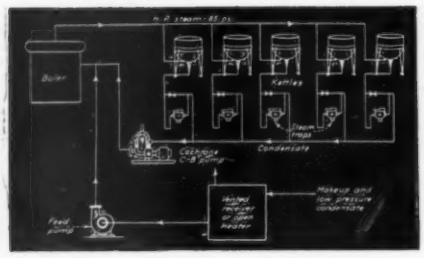
Portable Shields Useful For Pipe Welding Jobs

LIGHT-WEIGHT, portable welding shields that are easy to move around and set in position have been designed by welders in the Mechanical Department at the Bayway refinery of Esso Standard Oil Co. The shields are used primarily when lengths of pipe are being butt-welded in the field, but also find application for other work and in the shop.

Made in the refinery, the shields are fabricated of 16-gage sheet metal,







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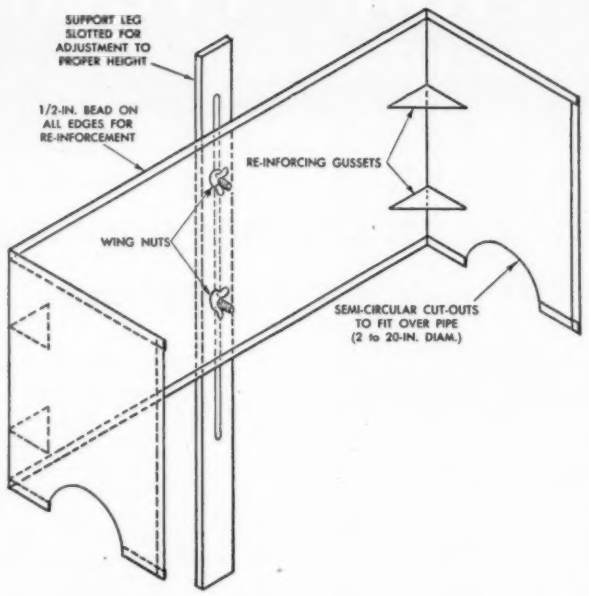

SUPPORT LEG SLOTTED FOR ADJUSTMENT TO PROPER HEIGHT
1/2-IN. BEAD ON ALL EDGES FOR RE-INFORCEMENT
RE-INFORCING GUSSETS
WING NUTS
SEMI-CIRCULAR CUT-OUTS TO FIT OVER PIPE (2 to 20-IN. DIAM.)

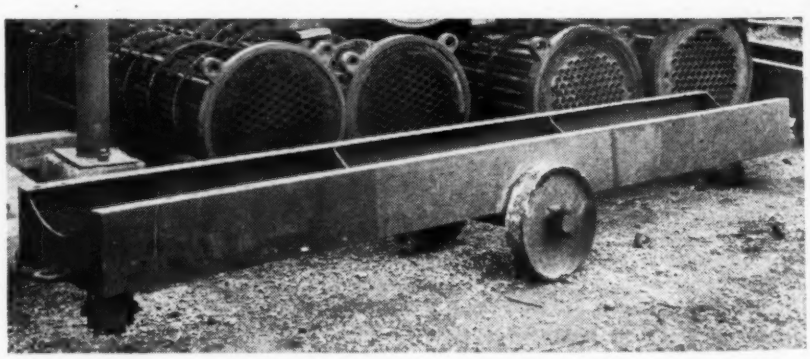
Fig. 1 — Esso pipe welders use this portable shield for jobs in the field

bent into a "U" shape and with semi-circular cutouts at either end to fit over the pipe, as shown in the accompanying sketch, Fig. 1. They are about 4 ft. long and 18 in. high, and vary in depth from about 12 to 30 in., depending upon the size of the cutout. Different shields have different diameter cutouts, to accommodate varying pipe sizes, from 2 to 20-in.

The right-angle bends are reinforced with sheet metal gusset plates, one at either end on the smaller-sized shields and two on the larger. To add further rigidity to the shields, a half-inch bead is bent back on all edges.

When in use the shields are held in position by a single wooden leg attached to the back of the shield with two bolts and thumb screws. The bolts fit through a slot in the upper portion of the leg, permitting adjustment to the desired height, as indicated in Fig. 1.

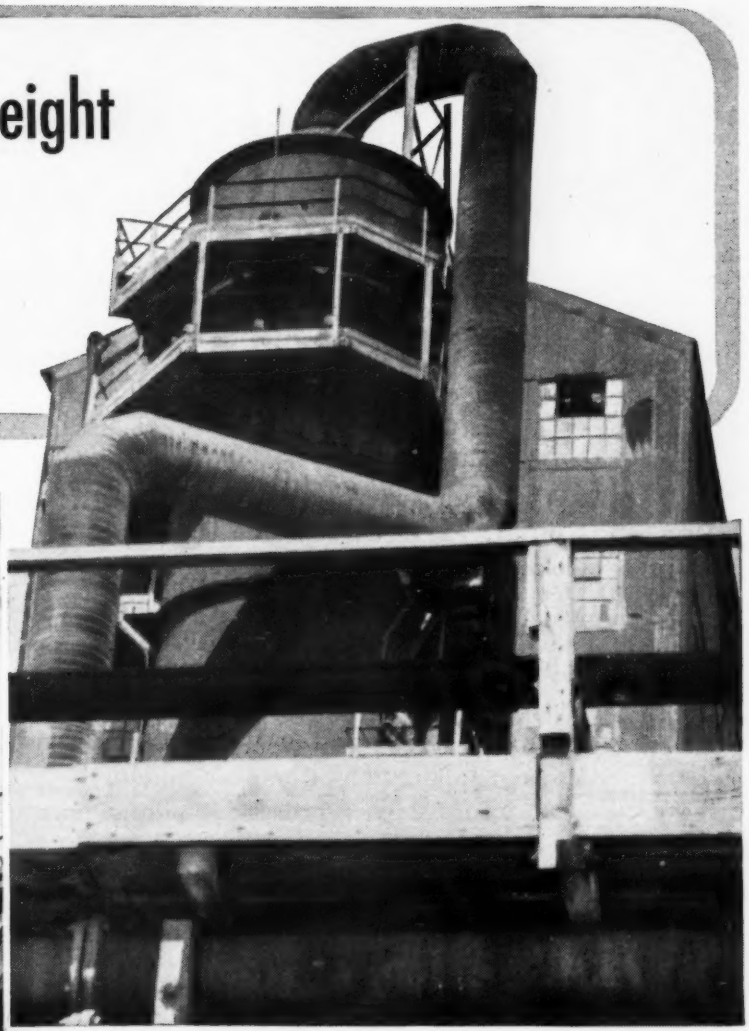
No Damage to Bundles in these Carts



MOVEMENT of tube bundles around the crude still areas at Gulf Refining Co.'s Cleves, Ohio, refinery has been greatly simplified by use of a set of rugged, shop-built carts, in which bundles of various lengths can be transported without damage to the tubes.

As illustrated in the photograph the body of the cart comprises two 8-in. channels, 12 to 14 ft. long connected by four ¼-in. thick cross-members. The large center wheels are cut from 12-in. pipe: the smaller casters at each end are 4-in. pipe. The center section of the chassis is painted a bright red, warning operators to keep their feet "out from under."

"We like its lighter weight when we're hanging *Clad Steel* Pipe"



60-inch pipe made of Lukens Stainless-Clad Steel, on a tower at Columbia Chemical Division of Pittsburgh Plate Glass Co., Barberton, Ohio.

10-inch vapor line made of Lukens Stainless-Clad Steel, installed at an oil refinery.

"The piping we formerly used was corrosion-resistant but, by nature, it was *heavy*. Installing it was costly and supporting structures had to be similarly heavy. Now that the cost of clad steel pipe is comparable, we favor it."

Lukens Stainless-Clad Steel was used for the two installations pictured here. With different corrosive conditions, the choice might have been Nickel-Clad, Inconel-Clad or Monel-Clad Steel. Lukens makes them all—uniform claddings of the corrosion-resistant metals, permanently bonded to steel backing plates. Clad Steel pipe is available through various fabricators.

In many cases, processing plants served by such piping can also use Lukens Clad Steels elsewhere to advantage. Equipment is given long life, upkeep is held down and products are safeguarded against contamination. Lukens engineers will help select the claddings you need.

Bulletin 449 tells you more about Lukens Clad Steels. For a copy, write Lukens Steel Company, 443 Lukens Building, Coatesville, Pennsylvania.

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aluminum lasts...

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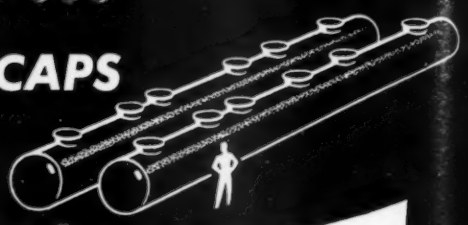

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Control Unit Assures Constant Speed Under Varying Load on Test Engine

IN engine test work it is necessary frequently to maintain constant speed under varying conditions of load. This requirement is particularly essential with tests on fuels and lubricants, where speed control immediately arises as a major consideration with respect to both the accuracy of test and the economy of personnel.

A speed control unit, developed at the Beacon, N. Y., research laboratories of The Texas Co., is designed for use on an engine-DC dynamometer setup and will control the dynamometer speed by automatically changing the field rheostat arm position to vary the field current whenever a change in engine torque, due to varying load characteristics, causes a deviation from the desired speed.

The essential elements of the speed controller are shown schematically in Fig. 1. Two shafts, X and Y, rotate in opposite directions. Shaft X is coupled to the dynamometer shaft and runs at dynamometer speed: shaft Y is connected to an auxiliary constant speed source. Shaft X carries pinion A, which serves as a sun gear, and shaft Y carries the internal ring gear B. The sun and internal gears are connected through four planetary gears C, mounted inside housing D, which is free to revolve about its axis, supported by bearings E.

The housing has a gear F cut into its periphery. The gear F meshes with spur gear G mounted on a shaft J, which connects through the gear reduction box K to the field rheostat. Pulley P on the rheostat shaft, is always weighted in the same direction, to eliminate backlash in the gear train. The gear F also meshes with spur gear M, mounted on the shaft of pump N, which serves as an oscillation damper.

Construction of the Unit

The photograph, Fig. 2, shows the speed control unit mounted in position at the rear extension of the dynamometer shaft. Referring to the numbers shown, the dynamometer shaft extension 1, supported in a ball bearing pillow block 2, is the shaft that drives the sun gear of the differential 3. The differential is the control unit proper and includes the housing and all internal gears, bearings, etc.

The constant, or pacing, speed source for the differential unit is an induction motor with a continuously variable transmission, shown at 4. This is a ⅓ hp., 1800 rpm., induction motor driving through a continuously variable speed transmission, which permits any desired output speed from 320 to 1725 rpm. The selection is made by adjusting the handwheel visible on the far side of the motor.

The pacing unit, driving through gears 5, rotates the internal ring gear of the differential at the output speed of the pacing unit, but in a direction of rotation opposite that of the dynamometer shaft. Extensions of the shafts which support the planetary gears are visible on the face of the differential unit nearest the dynamometer.

The dynamometer field rheostat arm 6 is driven from the external gear on the differential housing through a 50-1 gear reduction box 7. The weighted pulley for preventing backlash in the gear train is on the rheostat shaft, but not visible in the photograph.

The rheostat arm drive was modified as shown in Fig. 2 to permit manual as well as automatic control. This was accomplished by inserting a clutch handle inside the standard manual control handle so that the immediate rheostat drive gear 8 can be withdrawn from the gear train. Manual control is used for starting and for occasional control under unusual conditions. An oil pump, also not shown in Fig. 2, is geared to the external gear of the differential housing to reduce over-running and under-running of the correct rheostat position.

Principle of Operation

The principle of the speed control unit is explained by referring again

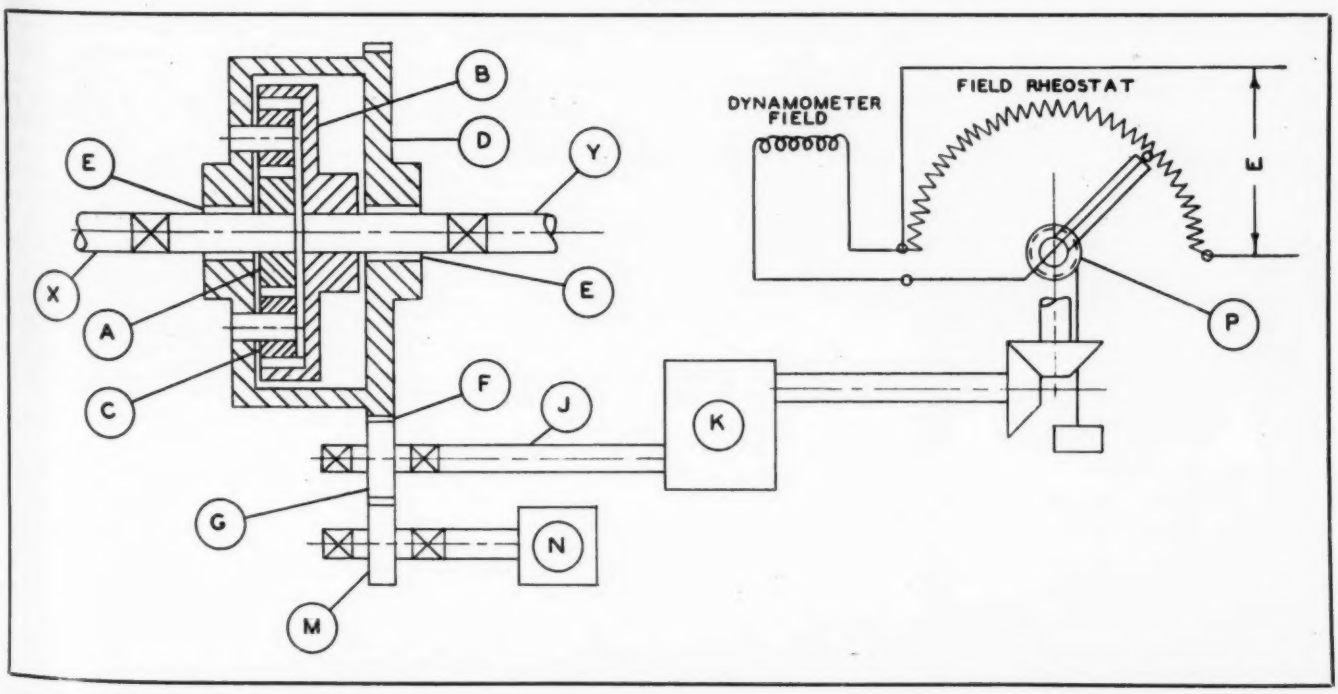

Fig. 1 — Analysis of speed controller action

AMMONIA
(REFRIGERATION GRADE)

DIRECT SERVICE
FROM
PRODUCING POINT
TO USER IN

TANK CARS
and
CYLINDERS

Discuss contract
shipments or
spot orders with

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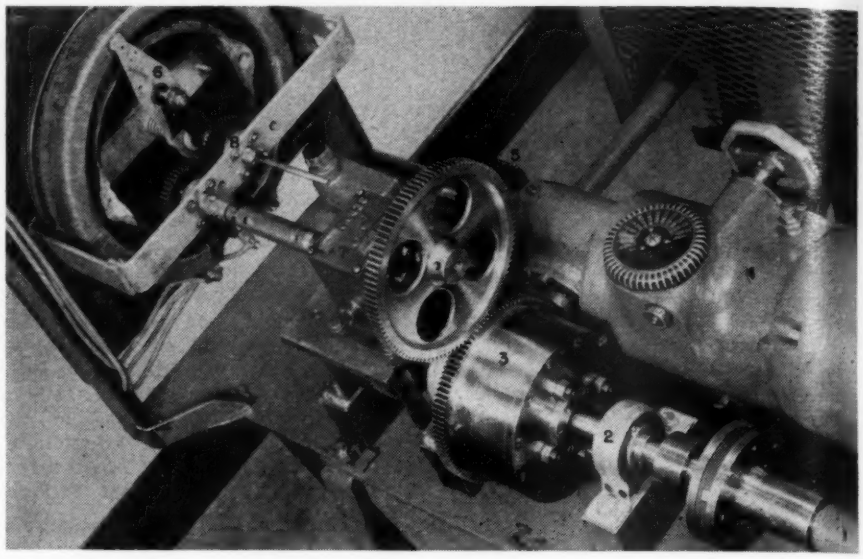

Fig. 2—DC dynamometer speed control unit

to Fig. 1. The angular velocities of shafts X and Y are designated ω and Ω_1 respectively. The ratio of the pitch diameters of gears A and B is designated as m. When the dynamometer torque balances the engine torque, and ω is equal to $m\Omega_1$, the speed controller housing remains stationary, and the position of the field rheostat arm and the resulting field current also are unchanged.

As the result of a change in engine torque, ω will momentarily differ from $m\Omega_1$, and the controller housing will rotate. This rotation will produce a change in the rheostat arm position and consequently a change in field current until the dynamometer torque equals the engine torque and the equality, $\omega = m\Omega_1$, is re-established.

In operation at a constant speed the angular displacement of the dynamometer shaft preserves a definite relationship to the angular displacement of the constant speed shaft, completing m times as many revolutions as the constant speed shaft during any time interval. In response to a change in engine torque, the dynamometer shaft gains or loses a few revolutions with respect to the constant speed shaft until the adjustment to the new dynamometer torque at the speed, $m\Omega_1$, is obtained.

Operating Experience

The speed control unit has been in use for a number of years on a GE TLC-24 DC dynamometer absorbing power from a supercharged CFR engine used in the knock rating of aviation gasoline. Operation was mostly at 1800 rpm. but has been carried out through a speed range of 600 to 3000 rpm. The speed control unit operated continuously to compensate for the varying load conditions that are characteristic of this type of testing.

During this period of operation the unit has required no maintenance beyond periodic lubrication, an SAE 10 grade oil being used in the differential housing.

An exact determination of the speed regulation of the dynamometer when the engine is operated at constant IMEP has not been made, and can be made only by special methods which were not considered worthwhile to set up, because the following evidence shows that the speed control unit gives much better regulation than methods tried previously:

1. Operation at 1800 rpm. showed no speed deviation on a tachometer sensitive to speed changes of 5 rpm. Thus the speed regulation was assumed to be at least 0.3%.

2. The differential unit alone serves as a differential tachometer and responds to differences in speed between the dynamometer and constant speed shafts, in such a way that when the dynamometer speed differs from $m\Omega_1$ by an amount $\Delta\omega$, the differential housing will rotate at a speed of $\Delta\omega/(1 + m)$. The differential housing motion thus provides a very sensitive measure of the speed error. This error may be estimated as $\Delta\omega = (1 + m)\ \Delta H$, where ΔH is the observed rate of motion of the differential housing.

Observations of the differential housing indicate a small periodic motion of about 2 to 4° occurring approximately every four seconds. From this, the speed error is estimated to be of the order of one-half of one rpm., or less than 0.05%.

The corrective action of the control in response to a sudden increase or decrease in engine torque can, within wide limits, be determined by the selection of gear ratio, rheostat winding, damping, etc. With the prototype unit these components have been selected to make complete speed correction within 10 to 15 seconds.

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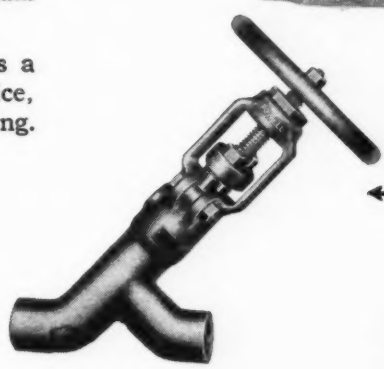

Fig. 1314-A—Class 1500-pound Steel "Y" Valve. Has integral bonnet and welding ends.

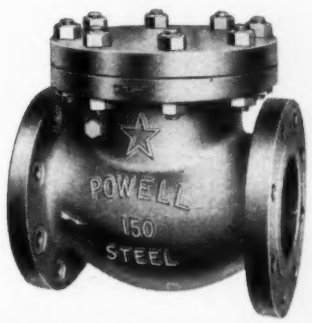

Fig. 1561—Class 150-pound Cast Steel Swing Check Valve with flanged ends and bolted cap.

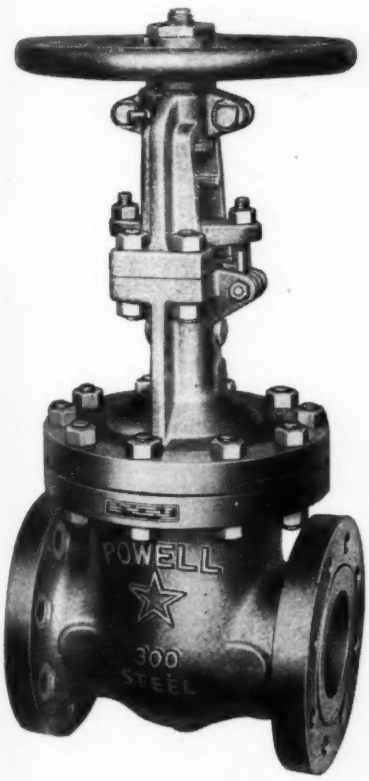

Fig. 3003—Class 300-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

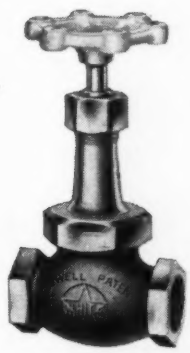

Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable wear-resisting "Powellium" nickel-bronze disc.

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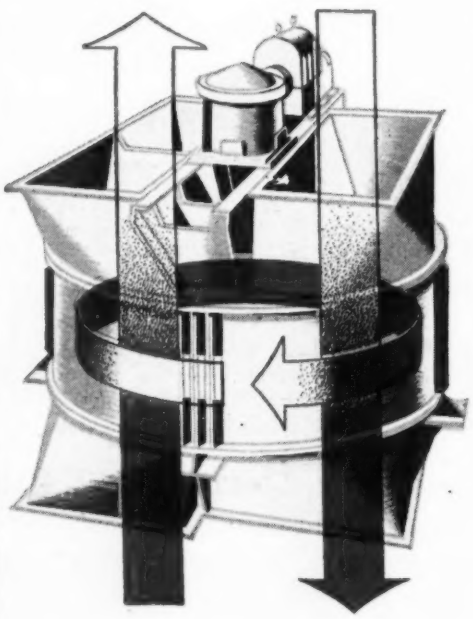

The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of leading power plants and other special applications confirm its high level of heat recovery and long-term low maintenance service.

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Patent Trends in Petroleum Refining

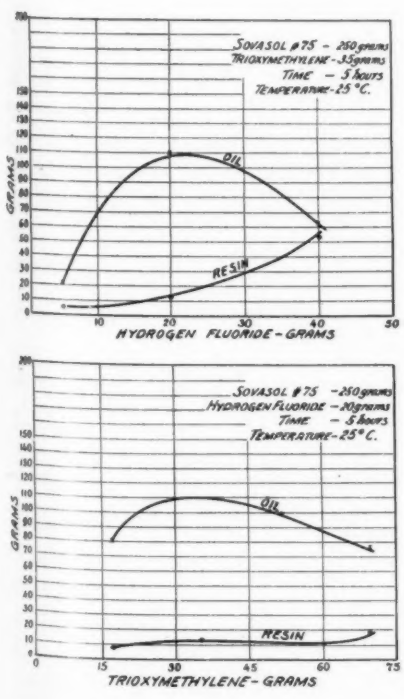
By Peter J. Gaylor, Editor "The Technical Survey"

Resins and Plasticizers From Petroleum Aromatics

INTEREST has been expressed(1) by some oil companies in the production of resins from petroleum aromatics. Polymers obtained as bottoms from hydroforming of heavy naphtha (and rich in naphthalene and alkyl naphthalenes) are said to have been condensed with formaldehyde to give 75-85% yields of resins suitable for linseed and tung oil varnishes.

The reaction is not a new one and the improvements appear to center around new raw materials and condensing agents. An early patent(2) to Standard Oil Development Co. showed the production of varnish resins by condensing formaldehyde with cracking coal tar fractions and similar materials. Another patent(3) to the same firm disclosed the condensation of a petroleum aromatic fraction (b. pt. 132-142° C. and 215-270° C.) with formaldehyde in presence of a water-soluble fatty acid (acetic) and zinc chloride, under anhydrous conditions, to produce resins for varnish use.

(1) *Technical Survey* 1949, p.495.
(2) U.S. 2,035,123 (Stand. Oil Dev. Co.).
(3) U.S. 2,216,941 (Stand. Oil Dev. Co.).



Figs. 1 and 2—Yields of oil and resin when condensing alkyl benzenes with aldehydes (Socony-Vacuum Oil Co.)

Subsequently, a Socony-Vacuum Oil Co. patent(4) described production of light colored resinous materials from petroleum aromatic fractions derived from catalytic cracking, and cyclization (b. pt. 300-400° F. and 500-750° F.), and thermally cracked fractions (b. pt. 400-600° F.).

Recently, Socony-Vacuum was issued another patent(5) on the same subject in which was stressed the use of hydrogen fluoride (preferably anhydrous) as the condensation catalyst, to produce viscous oils suitable as plasticizers for vinyl resins, and as softeners for synthetic rubbers and other plastic products.

Use is made of two aromatic raw materials, Sovasol No. 75 and an aromatic petroleum stock boiling at 400-425° F. The amount of hydrogen fluoride used varies from 5 to 15% by weight of the reaction mixture, and temperatures are maintained at between −5 C to 95°C. The aldehyde used is preferably formaldehyde, trioxymethylene or paraformaldehyde.

A mixture of oil and resin is obtained, the amounts and ratios being dependent upon the operating conditions. Figs. 1 and 2 show the yields obtained at different conditions with Sovasol No. 75 (containing alkylated benzenes), while Figs. 3 and 4 show results under varying conditions with an aromatic feed stock containing mainly polynuclear aromatics.

The resins obtained are mostly condensed ring compounds or benzene groups connected by short alkyl groups, while the oil appears to be predominantly a dimer of similar structure.

The highest yield of oil is obtained with a molar ratio of hydrocarbon to trioxymethylene to hydrogen fluoride of 2-1-1. One advantage in the use of hydrogen fluoride is that it is effective over a wide range of temperatures, both high and low, and it is a more powerful condensing agent when compared to hydrochloric or hydrobromic acids.

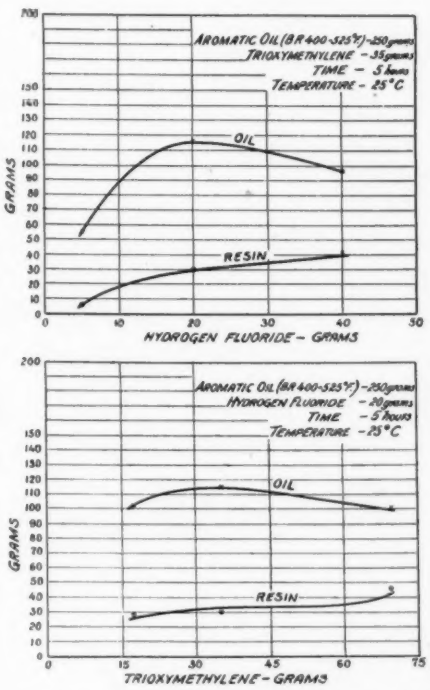
Another recent patent issued to California Research Corp.(6) also discloses the production of heavy oils which may be used for plasticizing purposes. In this case, aromatic hydrocarbons are condensed with olefinic polymers to produce long chain-alkylated aromatic hydrocarbons.

In this particular case, benzene is condensed with propylene tetramer (b. pt. 340-420° F.) or pentamer (b. pt. 420-510° F.), using anhydrous hydrogen fluoride as the condensing agent. This agent is particularly valuable since it does not decompose the branched chain alkenes into shorter chained fragments.

The new arylalkanes are produced in accordance with the flow sheet shown in Fig. 5 Benzene and polypropylene are first dried in tower 12 and passed into reactor 14 provided with cooling jacket 16 and internal stirrer 17 operated by external field coil 19. Hydrofluoric acid is fed in through line 21.

The reaction mixture leaving the reactor is settled in settler 25, so as to recycle bottom acid layer 26 back to the reactor, while the top layer is washed in tower 28 and distilled in fractionators 33, 37 and 41, the final phenyl alkane product being taken off as overhead through line 42. Reaction temperature is maintained at 20-50° F. and amounts of hydrofluoric acid, such as 200-800 mol % of the olefin are employed. Excess aromatic is used since it is usually cheaper than the alkene.

One product obtained in this man-



Figs. 3 and 4—Yields of oil and resin when condensing polycyclic aromatics with aldehydes (Socony-Vacuum Oil Co.)

(4) U.S. 2,397,398 (Socony-Vacuum Oil Co.).
(5) U.S. 2,477,538 (Socony-Vacuum Oil Co.).
(6) U.S. 2,477,382 (Calif. Research Corp.).

ner, a mixture of isomeric monophenyl dodecanes, has the following inspections:

Gravity (A.P.I.)	30.9
Refractive index	1.4884
Specific dispersion ..	128
Viscosity at 100° F. ..	6.60 cs.
Viscosity at 210° F. ..	1.80 cs.

Desulfurization of Naphthas

ONE method for removal of sulfur, disclosed in U. S. 2,478,603, issued to Phillips Petroleum Co., involves consecutively contacting a stream of hydrocarbons with a series of alkaline washes of progressively increasing strength, the final wash containing plumbite in solution. By this practice, it is claimed that the effectiveness of the desulfurization is substantially increased.

The method may be more clearly understood from Fig. 6 which shows, diagrammatically, the steps involved. For example, an alkylation stock consisting mainly of C_4 hydrocarbons, with some C_3 and C_5 constituents, and containing 0.08% mercaptan sulfur and 0.0015% hydrogen sulfide sulfur, is liquefied and treated in a prewasher 11 with a 10% solution of caustic soda. Substantially all of the hydrogen sulfide is converted to sodium sulfide. Thereafter, the hydrocarbon mixture is treated successively in the caustic washers 15, 18 and 21 with caustic of increasing strength, and finally in the last washer 24 with approximately 25% caustic soda solution containing 7.86 lbs. litharge per bbl. of caustic solution, which is fed in from storage tank 25. With such treatment, the finished hydrocarbon drawn from line 27 contains no hydrogen sulfide sulfur and only 0.0015% mercaptan sulfur.

The spent litharge-caustic solution is regenerated in regenerator 28.

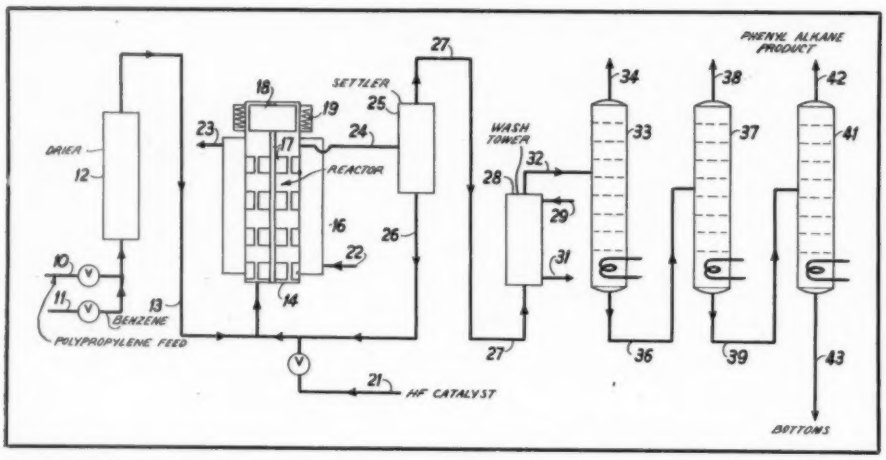


Fig. 5—Alkylation of benzene with propylene polymers, as patented by California Research Corp.

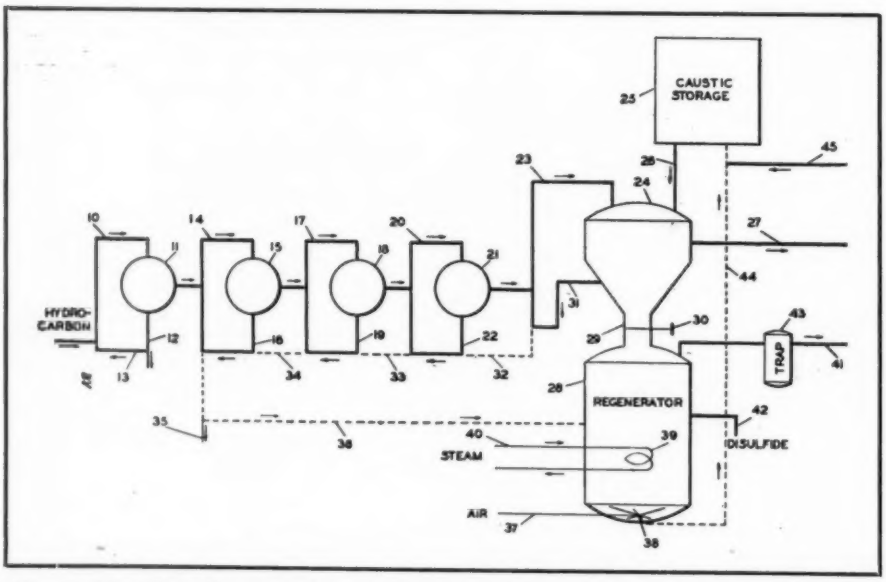


Fig. 6—Flowsheet for stepwise sweetening with increasing strength caustic and plumbite finishing (Phillips Petroleum Co., U.S. 2,478,603)

Patents Issued During August

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of direct interest to the petroleum processing industries, as contained in the Official Gazette of the U. S. Patent Office for August 2-23, Vol. 625, Nos. 1-4.

Fuels

2,479,326 (Std. Oil Development Co.)—Leaded antiknock motor fuel.
2,479,470 (Union Oil Co. of Calif.)—Asphaltic jet propulsion fuel.
2,479,900-3 (Ethyl Corp.)—Antiknock mixtures.

Conversions

2,477,638 (Houdry Process Corp.)—Silica-zirconia.
2,477,639 (Houdry Process Corp.)—Activating kaolin clay.
2,477,664 (Houdry Process Corp.)—Acid-activating kaolin clay.
2,477,695 (Std. Oil Development Co.)—Treating hydrosols with fluorides to improve gel catalysts.
2,477,740 (Universal Oil Products Co.)—Hydrocarbon dehydrogenation using hydrogen as a process gas and carbon dioxide as a stripping medium.
2,477,750-1 (Std. Oil Co.—Indiana)—Conversion of hydrocarbons with suspended catalyst.
2,478,194 (Houdry Process Corp.)—Catalyst pellet.
2,478,519 (American Cyanamid Co.)—Producing silica base gel catalysts.
2,478,675 (Shell Development Co.)—Removal of alkali from alumina.
2,478,707 (Std. Oil Development Co.)—Catalytic reactor.
2,478,900 (Koppers Co.)—Rendering non-corrosive the products resulting from catalytic alkylation.
2,478,916 (Universal Oil Products Co.)—Catalytic reforming of gasoline.
2,479,109-10 (Universal Oil Products Co.)—Alumina-platinum-halogen catalyst for reforming gasoline (platforming?).
2,479,366 (Std. Oil Development Co.)—Alkylation of iso-paraffins with olefins.

Refining

2,477,595 (Pure Oil Co.)—Fractionally distilling in alternate heating and cooling zones.
2,477,929 (Calif. Research Corp.)—Fluid mixing device.
2,478,456 & 72 (Socony-Vacuum Oil Co.)—Solvent dewaxing.
2,478,603 (Phillips Petroleum Co.)—Desulfurization of light hydrocarbons.
2,478,686 (Std. Oil Development Co.)—Apparatus for heating fluids.
2,478,710 (Std. Oil Development Co.)—Stabilizing hydrocarbons.
2,478,934 (Morse)—Separating oils from mixtures.
2,479,108 (Universal Oil Products Co.)—Fractional distillation.
2,479,238 (Calif. Research Corp.)—Treating sulfur-containing hydrocarbon mixtures.

Chemicals

2,477,579-80 (Calif. Research Corp.)—Electrolytic process for producing cyclohexadiene dicarboxylic acid.
2,477,715 (Gulf Research & Development Co.)—Azeotropic distillation of styrene-containing hydrocarbon fractions.
2,477,872 (Shell Development Co.)—Ureas.
2,478,045 (Shell Development Co.)—Stabilization of butadiene with salicylates.
2,478,066 (Shell Development Co.)—Polymerization of olefins in presence of nitrogenous compounds.
2,478,154 (Shell Development Co.)—Polymeric aldehyde diesters.
2,478,243 (Union Oil Co. of Calif.)—Mononitrobutadiene, b. p. 118-9°C.
2,478,270 (Universal Oil Products Co.)—Olefins by dehydrating alcohols.
2,478,299 (Celanese Corp.)—Purifying mixtures of olefins and diolefins.
2,478,451 (Socony-Vacuum Oil Co.)—Polymerizing drying oils.
2,478,452 (Socony-Vacuum Oil Co.)—Pyrrole.
2,478,464 (Socony-Vacuum Oil Co.)—Aromatic nitriles.
2,478,484 (Socony-Vacuum Oil Co.)—Acyl thiophenes.

AT GULF OIL CORPORATION'S Spear Gasoline Plant, Kilgore, Texas, liquid propane is pumped directly into storage tanks. While awaiting shipment, only free water is drained off. Then the propane is dehydrated on its way to the tank cars.

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It is one of the few solid types of adsorbents that does not change its form or properties. Being noncorrosive and inert, ALCOA Activated Alumina has no effect on the product even when the latter stands in contact with the alumina for long periods.

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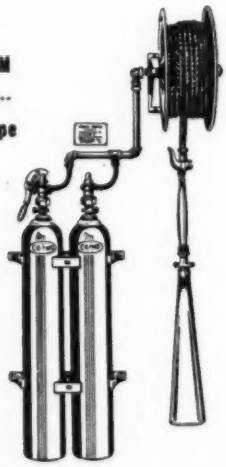

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Patent Trends

2,478,703 (Std. Oil Development Co.)—Recovering rubbery polymers from purge water.
2,478,718 (Std. Oil Development Co.)—Anti-tack agent for rubbery polymers.
2,478,776 (Phillips Petroleum Co.)—Catalytic oxidation of hydrocarbons.
2,478,875 (Rohm & Haas Co.)—Hydrogen cyanide in high yields by reacting hydrocarbons, ammonia and oxygen.
2,478,914 (Shell Development Co.)—Benzothiophenes.
2,479,120 (Universal Oil Products Co.)—Relatively straight chain alkyl aromatic hydrocarbon production.
2,479,202 (Std. Oil Co.—Indiana)—Recovery of sulfonic compounds from sulfuric acid sludge.
2,479,283-4 (Shell Development Co.)—Dihydropyran derivatives.
2,479,360 (Std. Oil Development Co.)—Polymerizing hydrocarbons.
2,479,418 (Std. Oil Development Co.)—Olefin dimers as promoters in low-temperature Friedel-crafts polymerization.
2,479,618 (Atlantic Refining Co.)—Polymerizing alkyl styrenes.
2,479,781 (Phillips Petroleum Co.)—Purifying hydrogen sulfide.
2,479,879 (Sinclair Refining Co.)—Nitriles and amines from ammonia and olefins.
2,479,996 (Pure Oil Co.)—Synthesis of organic sulfur compounds.
2,480,021 (Phillips Petroleum Co.)—Vinyl fluoride from acetylene.
2,480,056 (Gulf Oil Corp.)—Heterocyclic nitrogen base salts of 3-methyl-butyl, 2 ethyl-hexyl orthophosphate.

Lubricants

2,477,598 (Hain)—Microworker for lubricating greases.
2,477,913 (Shell Development Co.)—Mineral lubricating oil containing Zn salt of diisopropyl salicyclic acid.
2,478,694 (Std. Oil Development Co.)—Lubricant containing cyclized, phosphorated polymer.
2,478,843 (Monsanto Chemical Co.)—Mineral oil thickened with cyclohexylstyrene polymer.
2,478,917 (Hain) — Apparatus for making grease.
2,479,407 (Socony-Vacuum Oil Co.)—Hydroxy-aromatic phosphorus amine-phosphorus sulfide reaction products.

Hydrocarbon Synthesis

2,478,899 (Koppers Co.)—Reactivation of catalysts in hydrocarbon synthesis.
2,479,420 (Std. Oil Development Co.)—Catalyst recovery in hydrocarbon synthesis process.
2,479,435 (Std. Oil Development Co.)—Reducing iron group metal oxides.
2,479,439 (Std. Oil Development Co.)—Hydrocarbon synthesis operation.
2,479,496 (Hydrocarbon Research)—Controlling catalytic exothermic reactions of gasiform reactants.
2,479,999 (Phillips Petroleum Co.)—Regeneration of catalysts used in production of hydrocarbons from carbon monoxide and hydrogen.

Specialties

2,478,162 (Shell Development Co.)—Asphalt with binder of sulfur and oleophilic aliphatic mono-amine.
2,478,654 (Lonvroil-Montbard-Aulnoye) — Coal tar pitch-anthracene plastic bitumen.
2,479,762 (Phillips Petroleum Co.)—Corrosion preventing composition.

Miscellaneous

2,478,682 (Std. Oil Development Co.)—Generating power.
2,478,951 (Calif. Research Corp.)—Flaw detection fluid.
2,479,840 (Shell Development Co.)—Refrigeration method for box cars.
2,479,866-7 (Shell Development Co.)—Liquid air refrigerator.

How to Obtain Patents

Readers may obtain copies of any U. S. patents from the Patent Office at 25 cents each. Order by patent number direct from: The Commissioner of Patents, Washington 25, D.C.

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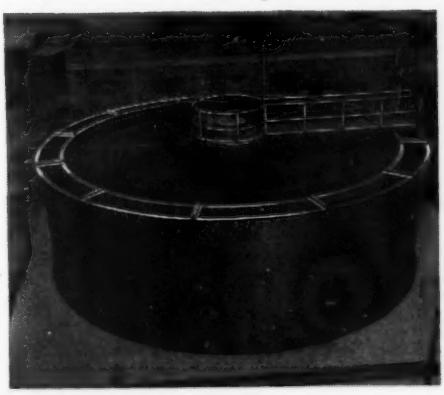

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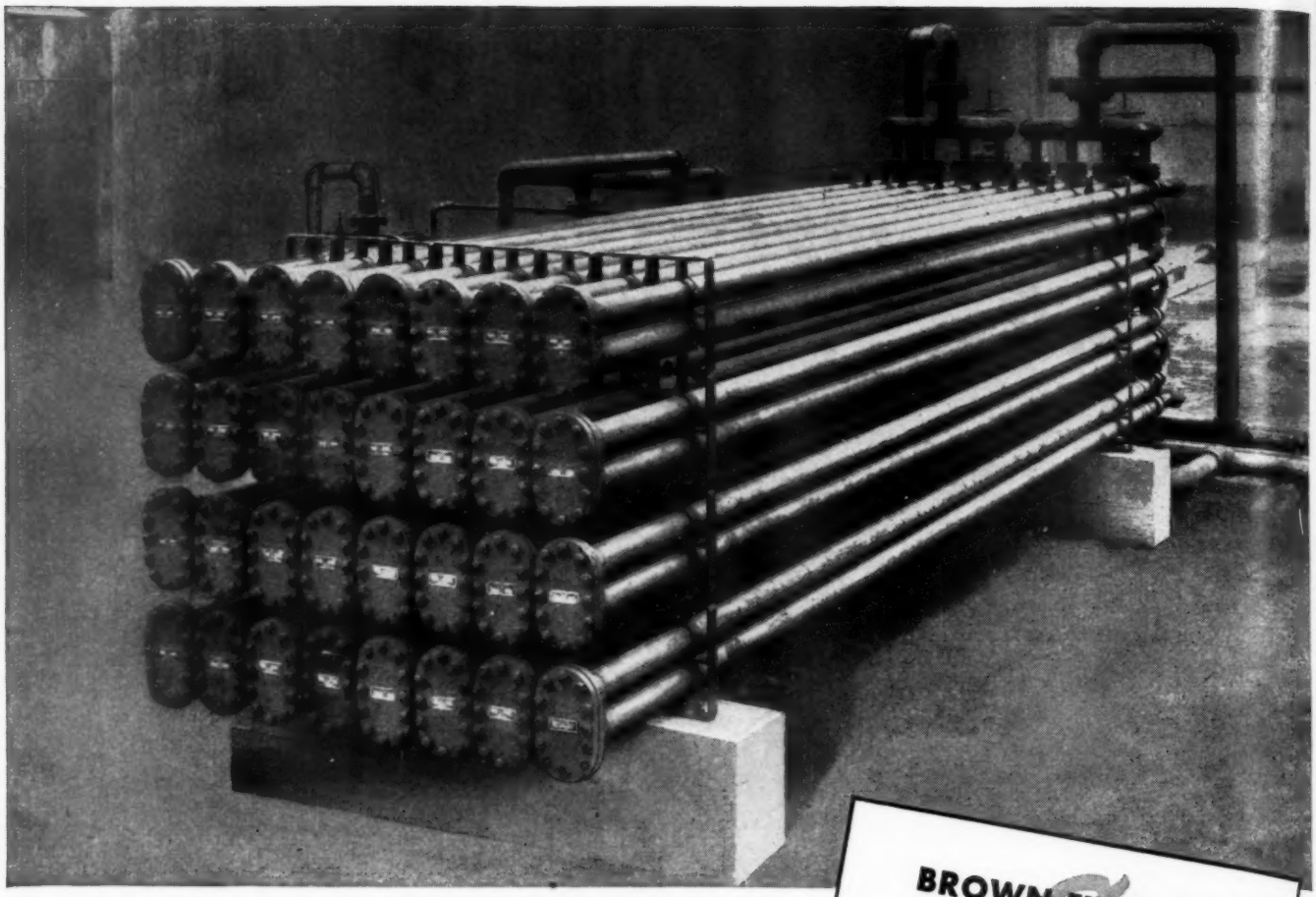

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SECTIONAL HAIRPIN HEAT EXCHANGERS

Workman Can Move Both Ways Through Fractionator Manways

In addition to the two-direction manway for fractionators described below, this month's review of new and improved devices used in petroleum processing and handling operations on which patents have been issued recently includes an improved nipple for catalytic vessels.

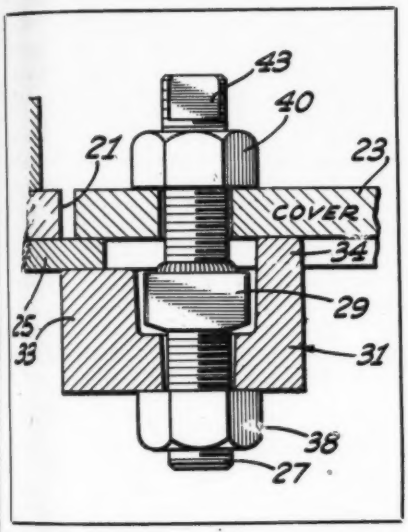

Fig. 1—Special lug and nut for securing manway covers inside bubble tray columns (U. S. 2,476,009)

CLOSING LUGS and bolts have been designed for manway covers for fractionation bubble trays which can be secured or released from either side with a pair of ordinary wrenches. This enables a maintenance workman to move through the tower in either direction.

The fastening device is illustrated in Fig. 1, in which the bubble tray proper is indicated by 21, the manway cover by 23, and the cover support ledge, or ring, by 25. Stud bolt 27 has a square nut 29 threaded up to about the midpoint and welded into position. Lug 31 has two upwardly extending ears. Ear 34 presses against the cover 23 and ear 33 against the support ledge 25. Inner faces of these ears fit against two faces of the nut 29.

In use, if the workman is below the cover, he holds the lug with one wrench, thus preventing stud bolt 27 from turning. With the other wrench he can turn lower hexagonal nut 38. If he is above the cover, he holds bolt 27 by a wrench across the flats 43 at its upper end, and then turns the upper nut 40.

U. S. 2,476,009, issued July 12, 1949, to Arnold Wessman, assignor to C. F. Braun & Co., Alhambra, Calif.

Double Flange Solves Wear Problem on Vessel Nipples

NIPPLE CLOSURE ASSEMBLIES, particularly those for catalytic reaction vessels, tend to become worn or damaged at the flange when catalyst is charged or removed. Because the usual nipple flange is integral with the vessel, it can't be removed without considerable difficulty. Further, it is extremely difficult to reshape the flange by machining it in place.

This problem is overcome by utilizing a double flange design such as is shown in Fig. 2. In this assembly, a ring flange, secured to but removable from, the vessel's fixed flange, will take the wear and tear when the nipple is open. Once worn, the flange can be easily replaced.

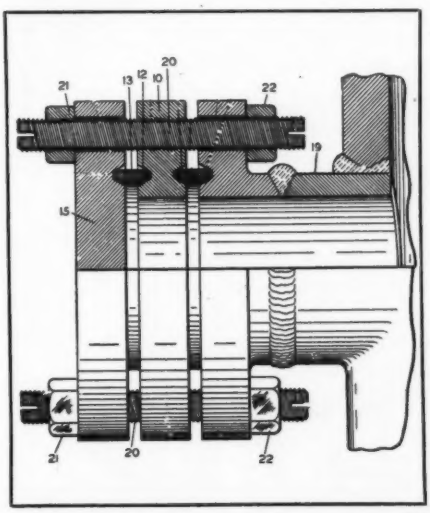

Fig. 2—Additional ring flange 10 aids in maintenance of catalytic vessel nipple 19 (U. S. 2,479,612)

For ordinary opening of the nipple 19, nuts 21 are unscrewed and cover plate 15 and ring 13 are removed. When after a time, ring groove 12 becomes worn, nuts 22 are unscrewed and ring flange 10 is replaced. This is made possible by having stud bolts 20 threaded into female threads in ring flange 10.

U. S. 2,479,612, issued August 23, 1949, to Joseph D. Glidden, assignor to Phillips Petroleum Co., Bartlesville, Okla.

Other Recent Patents

Space does not permit the complete review of all patents issued recently on equipment for the petroleum processing industry. Following, however, are brief abstracts of those with the greatest interest.

Wax Cooler for multiple-phase mixtures, using a rapid chilling step and repeated cycles of heat transfer so as to reduce the heat exchange surface required and lower the cost. U. S. 2,478,863, issued August 9, 1949, to Hyman R. Davis, assignor to The Lummus Co., New York City.

Air-operated Control Valve in which the valve member is locked in position it occupies at that instant when the air supply fails, said to overcome the usual difficulty with conventionl valves wherein valve will completely open or close in the event of air supply failure. U. S. 2,479,454, issued August 16, 1949, to Douglas H. Annin, assignor, by mesne assignments, to Fluid Control Engineering Co., Emeryville, Calif.

Fire Foam Spray Head and Tube said to overcome waste of foam because excessive turbulence in the mixing chamber causes it to weep out rather than be carried through with the main discharge. U. S. 2,478,998, issued August 16, 1949, to Fisher L. Boyd and Lewis W. Boerner, assignors to National Foam Systems, Inc., Philadelphia.

Continuous Grease Making Equipment for such types as lithium soap greases, providing for internal cooling in several successive stages. U. S. 2,478,917, issued August 16, 1949, to George M. Hain, United States Navy.

Positive Displacement Pump of the rotary vane type in which it is said efficiency can be improved when worn parts are replaced. U. S. 2,479,685, issued August 23, 1949, to Carl H. Ingwer, Elyria, Ohio.

Seal for Pump Shafts and the like, designed as a cartridge type for easy

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WORK-SAVER PIPE TOOLS
THE RIDGE TOOL CO. • ELYRIA, OHIO

installation and a minimum amount of service and repairs. U. S. 2,479,711, issued August 23, 1949, to Armais Arutunoff, Bartlesville, Okla.

Tube Alignment Clamp, for use on refinery furnaces and other tubular equipment and designed particularly to aid in the disassembly or reassembly of return bends, and to prevent spreading or twisting of tube ends. U. S. 2,477,884, issued August 2, 1949, to John E. Loeffler, assignor to Thornhill-Craver Co., Houston.

Cracking Furnace of low-cost, A-type design, utilizing crossed or interlocked arched tubes for the roof section as well as arranged in a series of tube banks on the side walls to permit zone heating and varied rates of heat input. U. S. 2,479,544, issued August 16, 1949, to Otto C. Schauble, assignor to The Lummus Co., New York City.

Microworker for Lubricating Greases, consisting essentially of a pair of syringes connected end-to-end, with a fine wire screen in the space between them to aid in the shearing action required, and said to accomplish in 500 passes what will result in 100,000 passes through an ASTM plate. U. S. 2,477,598, issued August 2, 1949 to George M. Hain, Montclair, N. J.

Stabilizer for Lifter Roof Storage Tanks, designed to maintain the roof in a horizontal position although unequal loads may be placed on it. U. S. 2,477,564, issued August 2, 1949, to Christian Arne, assignor to Chicago Bridge & Iron Co., Chicago.

Flow-measuring Device useful for determining conversion rates in petroleum processing equipment; for example, by metering the quantity of polymerized gasoline withdrawn as a liquid from the reaction chamber wherein butene is being polymerized to octane. U. S. 2,473,765, issued June 21, 1949, to Vern G. Platts, assignor to Phillips Petroleum Co., Phillips, Texas.

Reflux Distillation Condenser for use in laboratory work designed to obtain a constant reflux ratio, and including a simple adjustment for automatically maintaining any of a number of predetermined ratios selected. U. S. 2,476,477, issued July 19, 1949, to Lloyd Berg, assignor to Gulf Research & Development Co., Pittsburgh, Penna.

How to Obtain Patents

Readers may obtain copies of any U. S. patents from the Patent Office at 25 cents each. Order by patent number direct from: The Commissioner of Patents, Washington 25, D. C.

What's New!

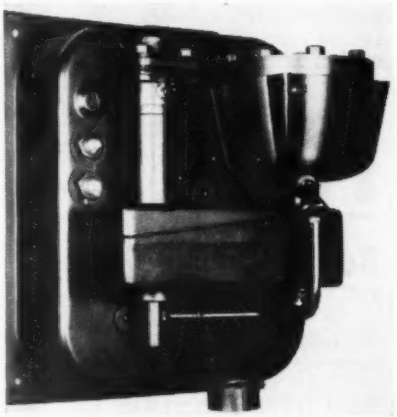
EQUIPMENT . . . MATERIALS . . . PROCESSES . . . LITERATURE

Reviewed by WILLIAM C. UHL, Equipment Editor

New Products at ISA Show

SEVERAL new instruments and accessories, shown publicly for the first time, at the Fourth National Instrument Conference and Exhibit in St. Louis, Sept. 12-16, received considerable attention from petroleum and chemical industry instrument engineers among the visitors. Some of them are mentioned briefly in the article beginning on page 1097 and are reviewed in more detail below, items 1 through 6 and 23 through 25.

1—Magnetic-type Flow Meter



The Hays-Penn "Magna-Clutch" flow meter utilizes a magnetic clutch to transmit the float movement instead of the conventional mechanical linkage arrangement, thus providing more power with less friction. The operating principle of a magnetic clutch is not entirely new, the manufacturer states; however, its development has been hampered by the scarcity of high-power magnets and non-magnetic metal wall material of sufficiently high tensile strength. The instrument employs large float (3.75 in. in diameter) with long float travel (1.5 in.). No stuffing box is required. Five adjustable range tubes give wide rangeability—from 17 to 750 in. water differential. Working pressures are given as 1500 and 2500 psi., convertible in the field. Six types or combinations of recording, indicating, and integrating meters are offered. The meters are now in production and deliveries can be made promptly. **Shown at Instrument Exhibit.** The Hays Corp.

For More Information

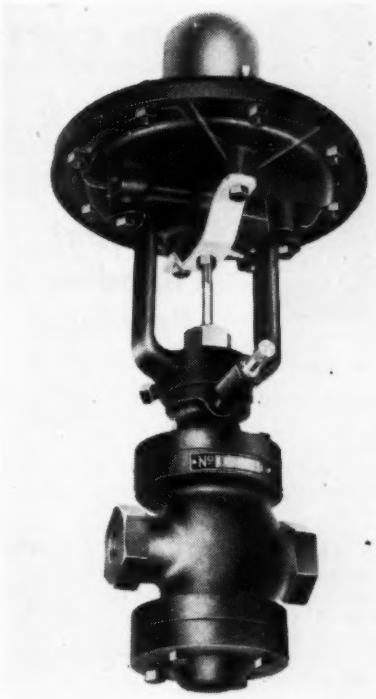
Use one of the attached reply cards to request additional information or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers on the items you're interested in, fill in the rest of the card, and drop it in the mail. **No postage required.**

2—Instrument Housings

Designed primarily for the petroleum and chemical processing industries, "Gilbarco" instrument housings are standardized in several basic sizes and for typical mountings, such as pedestal pipe, wall, or horizontal pipe mounting. The cabinets, available with or without 11 in. square windows, are made of 18 ga. automobile body steel, "Bonderized" for corrosion resistance. They have foil-covered asbestos insulation. Easy accessibility to the interior is provided in several ways—hinged front panel door, thumb latched and specially hung rear door; or the entire front half of most models can be removed by releasing finger operated toggle clasps. All cabinets are 21 in. in width. Height ranges from 24, to 42, 55, and 64 in.; depths from 12¾, 15¾, 21, and 24 in. **Shown at Instrument Exhibit.** Gilbert & Barker Mfg. Co.

3—Reversible Valve Motor

The new Foxboro Reversible Motor for Stabilflo Valves makes possible quick reversibility of action in a few minutes' time without special tools, from "air to open" to "air to close" or vice versa. Also, it is not necessary to remove the valve from its installation nor shut down the controlled flow. To reverse the action of the valve motor, the housing assembly is removed, rotated one-quarter-turn, and replaced which requires the removal and replacing of four bolts. The design is now standard for Stabilflo valves in the most common sizes. **Shown at the Instrument Exhibit.** Foxboro Co.

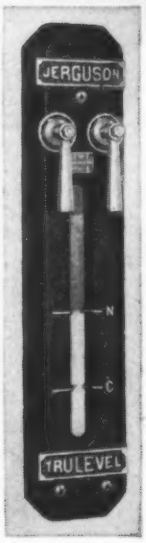


4—Air-driven Valve Motor

"Rotomotor" is a new control valve positioning operator employing a reversible pneumatic motor and a gear driven screw stem, capable of handling stem loads up to 10,000 psi., stem travels up to 20 in. Operating on 100 psi. air, it provides extra power and long stroke without resorting to

More "What's New!" Items, p. 1138

Here's A Better Way To Read Water Levels Of Inaccessible Boiler Drums!



Use New

JERGUSON TRULEVEL GAGES

For All Distant Reading Problems

JERGUSON TRULEVEL Gages are the ideal solution to your problem when you need to read boiler water level accurately at a distant point, as in the case of inaccessible waste heat boilers.

TRULEVEL brings the liquid level reading of water, or of any condensing medium which you may be using, right down where you can see it. Complete accuracy of reading is assured by the use of a new type datum column, located at the drum.

Quick checking at the distant reading point is another important feature of TRULEVEL, and this is patented and exclusive with Jerguson. By simply turning the two valve handles on the cover it is possible to check gage accuracy *in a matter of seconds*. For accuracy and safety use the Jerguson TRULEVEL.

IMPORTANT! *Manometric fluid used in TRULEVEL Gage is color fast! Simple to maintain. No leakage. Another important feature of Jerguson TRULEVEL Gages.*

Write for Jerguson Trulevel Data Unit No. 38, without obligation, today!

JERGUSON
GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Representatives in Major Cities
Phone Listed Under JERGUSON

What's New!

high operating pressures, outsize diaphragm castings, or long, heavy pistons. It will position to within 1/500th part of stem travel without overtravel, cycling, or "hunting." Pneumatic controller output pressure changes as small as 0.025 psi. will effect stem motion. Stem is self-locking in case of air failure. Stem speeds are available up to 10 to 12 in./minute. The unit is adaptable for mounting on large gate valves, butterfly valves, high pressure differential single-seated throttling control valves, and many others. **Shown at Instrument Exhibit.** Conoflow Corp.

5—Burner Safety Control

The "Flame-otrol" combustion safeguard is designed primarily for oil and gas fired furnaces, boilers, kilns, and the like. Using the conductivity principle of flame detection (ohmic resistance of flame, or that introduced to the input circuit of an electronic circuit through a photoelectric cell), it provides the speed of response required to detect presence or absence of flames and further provides a more positive means of distinguishing between unsafe firing conditions and normal variations in combustion conditions. The photocell is mainly sensitive to the blue portion of the flame spectrum, which predominates in an oil flame, and is extremely insensitive to extraneous light emitted from incandescent brickwork, etc. The new Model 1300 Series reduces the speed of response to range from 2 to 4 seconds so as to avoid shutdowns due purely to transient flame conditions. **Shown at Instrument Exhibit.** Wheelco Instruments. Co.

More "What's New!" Items, p. 1139

Building

- **FOR THE PETROLEUM INDUSTRY**
- We are fully staffed to design, build, and equip complete refineries and chemical processing plants.
- Under one contract and one responsibility, we deliver each job complete . . . ready for operation.
- We also furnish engineering reports and surveys. Current cost data available at all offices.

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INDUSTRIAL ENGINEERS AND BUILDERS

THE FERGUSON BUILDING • CLEVELAND, OHIO
OFFICES IN NEW YORK, HOUSTON, CHICAGO, CINCINNATI AND LOS ANGELES

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Booklet Tells How to Cut Cleaning Costs

NEW 32 Page Booklet on Low Cost "Serviced" Maintenance—cleaning for the Petroleum Industry — FREE! In it you'll find valuable data for handling such jobs as cleaning-descaling heat exchangers; reconditioning drums, barrels; cleaning tank car interiors; etc. We believe you'll find this booklet a handy reference guide for keeping cleaning costs down . . . production up. Write for your copy.

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Technical Service Representatives Located in Principal Cities of United States and Canada

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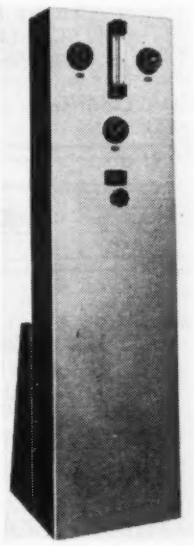
Specialized Industrial Cleaning
MATERIALS • METHODS • SERVICE

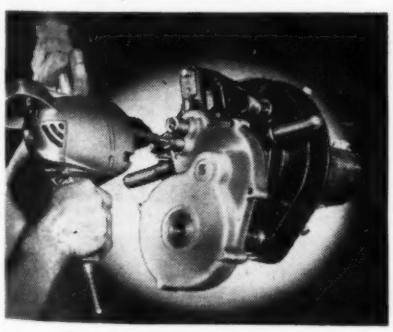
What's New!

6—Chlorination Apparatus



The new Builders' Volumetric Model DVS "Chlorinizer" is designed to accurately meter chlorine gas and to produce and deliver a chlorine-water solution to the point of application. It is equipped with automatic safety devices which shut off chlorine gas flow in the event any condition occurs which would affect its safe operation. Gas is kept under vacuum from the control valve to the injector to minimize the possibility of leaks. It uses a "Sightflo" chlorine rate indicator with linear scale for accurate reading at all rates. Tray-produced chlorine odors are eliminated by circulation of tray water. No hot water or bell jar heaters are required because the essential control parts handle dry, inert chlorine gas, completely eliminating "chlorine ice" difficulties. **Shown at Instrument Exhibit.** Builders-Providence, Inc.

7—Portable Pipe Threader



"Porta-Drive," a new portable pipe threader designed to fit in the average tool box, weighs but 14 lbs. One man can use it to thread up to 6-in. pipe in any position—in the field, in the shop, etc. Essentially a 20-1 gear reduction unit, the Porta-Drive is driven by any ½ hp., heavy-duty electric drill and attaches to any standard set of dies by especially designed adaptor-yokes. Muncie Gear Works, Inc.

More "What's New!" Items, p. 1140

PANELGRAPH

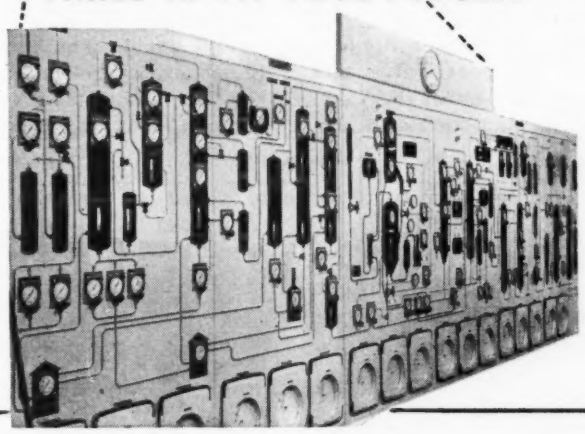
the *direct* approach to ON STREAM operation

visualize your entire plant at a glance

SPECIFY

PANELLIT

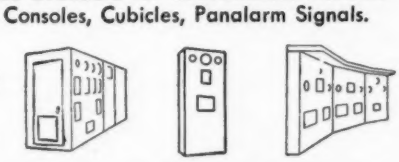
for the PREFABRICATED PANEL TO FIT YOUR PROCESS



This 25' Panelgraph Supervises the Operation of the Entire Refinery of The Rock Island Refinery Corporation, Indianapolis, Indiana.

It controls the operation of—
Crude & Vacuum Sections
Fluid Catalytic Cracking
Fractionation
Polymerization
LPG & Gas Concentration
From Crude to Finished Product on one Compact Panelgraph.
Prefabricated completely by Panellit.
Send for Brochure describing this installation.
Catalogues also available for Conventional Prefabricated Panels, Consoles, Cubicles, Panalarm Signals.

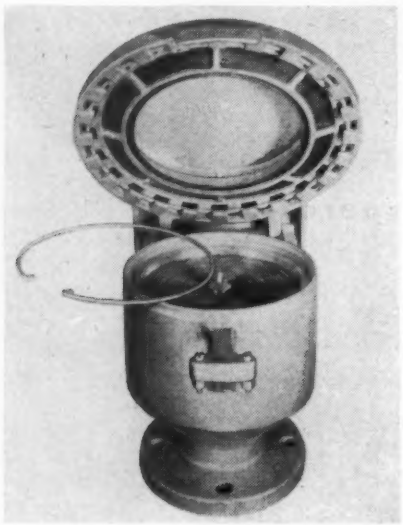
PROCESS INDUSTRIES
POWER PLANTS
REFINERIES



PANELLIT, INC.

7212 N. Clark Street • Chicago 26, Illinois

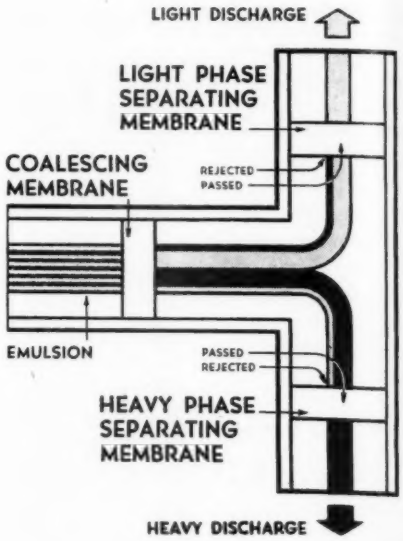
8—Vent Valve-Flame Arrestor

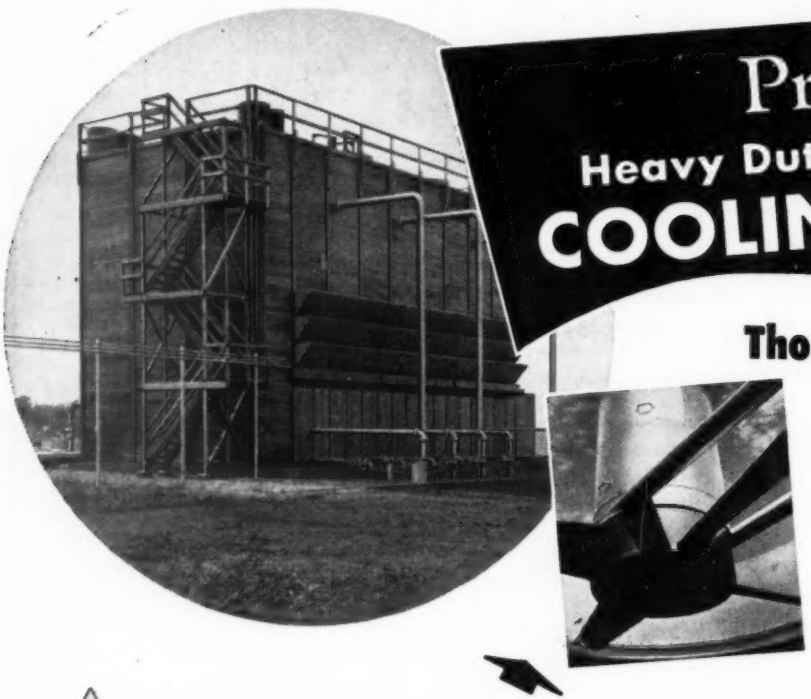


A combined vent valve and flame arrestor is said to provide fire protection for crude oil, gasoline, and other refinery tanks. The unit comprises a pressure-vacuum vent valve with a flame arrestor bank, which fits into the throat of the vent valve and becomes an integral part of the valve body. This bank, made of rolled aluminum, can be removed for cleaning or replacement by releasing the retaining ring spring. It does not interfere with normal venting, the manufacturer states. Black, Sivalls & Bryson, Inc.

9—Emulsion Separator

Complete phase separation and recovery of liquids, including stubborn emulsions, is accomplished at production rates by the new Selas Liquid Separator. It employs the physical principle of successive membranes, in which the first of the series has the function of coalescence and the second has the function of final separation. Rapid flow rates through the unit are permitted, from 500 to 1500 gals./hr., with relatively low pressure drops. Natural division of liquids by specific gravity brings the heavier liquid into contact with permanently pre-conditioned separatory membranes that pass it and reject the lighter liquid. The lighter liquid contacts other pre-conditioned separatory membranes as it rises to the upper section of the chamber and passes through. Finely dispersed droplets of the heavier liquid that reach the upper membranes are rejected and eventually fall to the lower chamber. Emulsions that have been stabilized chemically by surface-active agents cannot be separated. Shells of the units are constructed of carbon or stainless steel. Selas Corp. of America.





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Heavy Duty, Industrial Type

COOLING TOWERS

Thoroughly Engineered *

... Adequately Sized

* For Longer Life and Trouble-Free Performance

Pritchard's patented SEALDFLOW unitized, self-ventilating fan drive, available on new towers or as replacement units on any make of tower.

THREE LEADING LINES
Cooling Towers
Heat Exchangers
Gas Equipment for
FIVE MAJOR FIELDS
Chemical, Natural Gas, Petroleum, Power and Refrigeration.

EQUIPMENT DIVISION
908 Grand Ave. Kansas City, Mo.

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS • MANUFACTURERS
for the CHEMICAL, PETROLEUM, GAS & POWER industries

For detail information or competent consultation, write today. No obligation. Offices in principal cities from coast to coast.

What's New!

10—Prevents Fire Collapse

Development of a new light weight, Fireproofing cement to keep structural steel beams from collapsing during fires has been announced recently. Tests made by Underwriters Laboratories, Inc., certify that the material, applied in a layer 1¾ in. thick, will keep a beam from bending out of shape during a fire for three hours. The cement has approximately 1/10 the weight of solid concrete with the same fireproofing quality, and has been recommended for petroleum processing plants where the collapse of structural steel can be extremely costly. Eagle-Picher Co.

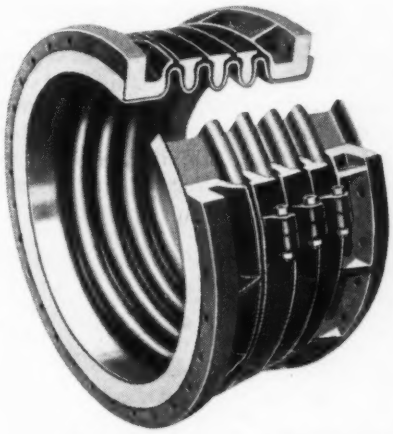
11—Overhead Platform

A new aluminum extension ladder with an aerial platform, designed for mounting on most materials-handling trucks or other truck bodies, is said to be useful for overhead maintenance and repair work in refineries and other petroleum processing plants. Standard model extends to a full height of 28 ft., and can be rotated a full 360 degrees. Other models are available for extension to 60 ft. Manual or hydraulic actuation controls the inclination of the ladder to as much as 14 ft. from the vertical. Unit includes the working platform at the top of the ladder. Aero Metalcraft Corp.

More "What's New!" Items, p. 1142

ANOTHER REASON WHY

Badger IS FIRST IN expansion joints



COMPACT

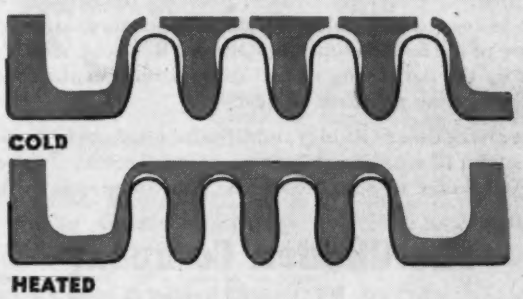
Installation and maintenance are easy — even in the tight places commonly encountered in refinery and petroleum processing pipe lines — when you use Badger Packless Corrugated Expansion Joints. Thanks to thoughtful designing, the outside diameter of any Badger Joint is about the same as an ordinary flange . . . installation is as easy as bolting in a new pipe section . . . space requirements are cut to a minimum.

And here are other features equally important to you:

- Flexible . . . quick response to heat expansion cuts strain on adjacent fittings and equipment.
- Packless . . . single tube construction provides pressure-tight joint without packing.
- Fabricated from stainless steel or alloys . . . joints withstand the high temperatures and corrosion encountered in oil refineries and other petroleum processing plants.
- Controlled Heat Treating . . . assures corrosion-resisting qualities for long life.
- Special forming methods . . . no danger of structure-weakening stresses.
- Directed flexing rings . . . to equalize stresses *between* and *within* corrugations.

These features are important in any pipe line job . . . you can get them all only by specifying Badger Expansion Joints.

Write today for Bulletin 100 (self-equalizing type) or Bulletin 200 (non-equalizing type).



EXCLUSIVE
all-curve corrugations equalize stresses

Although free to traverse axially, Badger Expansion Joints are constructed so that the Directed Flexing Equalizing Rings assure an even distribution of stresses whether caused by *temperature, pressure* or *movement* . . . there's no excessive strain at any point.

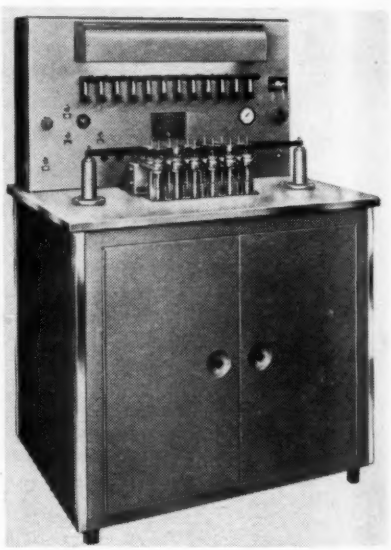
Badger MANUFACTURING COMPANY
230-260 BENT STREET • CAMBRIDGE 41, MASS.

12—Air-Foam Playpipe

Designed for fires which extend over wide areas, a new air-foam playpipe has been developed which can project a stream of foam 90 ft. in a compact jet, or spread out in a 30-ft. wide fan-shaped discharge up to 75 ft. It has a hinged tip which, when in operating position, provides the fan-shaped discharge. When it is snapped back out of position, the nozzle pours out a concentrated stream of foam. The unit fits a standard 2½ in. hose line, and may be used as a hand line which one man can handle satisfactorily at 100 psi. Its capacity is 1600 gpm. of foam. Pyrene Mfg. Co.

13—Lube Oil Tester

Precision Scientific Co., in cooperation with Standard Oil Co. (Ohio), has developed an improved apparatus for studying corrosion characteristics, oxidation stability, and the varnish and sludge formation tendencies of lube oils. Ten-hr. tests on the "Precision-Sohio Poly-Veriform" unit are said to correlate satisfactorily with the 36-hr. L4 Chevrolet test (ASTM). In addition, the Poly unit will evaluate 12 samples at once and is easily cleaned in a short time. In operation, a highly polished test piece of bearing metal is weighed and placed in 100 gms. of oil sample. A hardened steel drill rod weighing about 600 gms. is placed on the bearing metal to approximate the thrust load on a bearing. The entire set-up is heated to and held at 325° F. The drill rod then is rotated at 625 rpm. while air is bubbled through the oil sample at 70 liters/hr. The 12-unit cast aluminum bath is electrically heated and thermostatically controlled. Air flow is controlled by flowmeters and needle valves mounted in the panel. Precision Scientific Co.



14—High-pressure Pump Packing

"Hycar" synthetic rubber has been adapted in the manufacture of a plunger sealing ring or packing for Cooper-Bessemer "Twin-Line" high pressure liquid pumps which are used in hot and cold oil charging, and lean oil pumping in absorption plants, among other services. The primary function of the packing is to provide lip-type contact with the pump plunger in two directions. One lip seals against pump discharge pressure, the other against inward leakage of the packing lubricant. The seal proper is free to centralize itself with the plunger, thus eliminating uneven packing pressures. The Hycar compounds have high resistance to compression set, or "cold flow." Abrasion resistance is said to be 30-35% better than equivalent natural rubbers. B. F. Goodrich Chemical Co.

Refiners Report . . .

Superior

LUBE OIL, FUEL OIL, GREASE, GASOLINE

through the use of

GLIDDOL

by **Glidden,** *Pacemaker in Soya Research*

Many refiners have already discovered how Gliddol—the scientifically processed soybean derivative by Glidden—reduces surface tension to promote the thorough blending of oil or grease and additives. And from the combined evidence of laboratory tests and the experience of users, they report that this ideal blending agent and inhibitor gives greater protection to engine parts by effectively checking oxidation . . . gives oil and grease a longer life of usefulness by dispersing all insoluble solids.

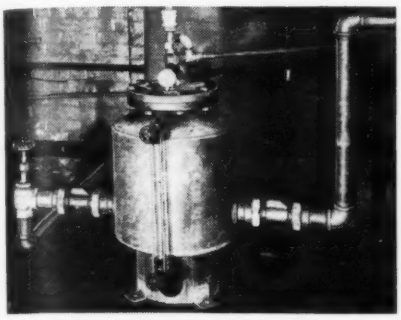
In the role of protective colloid, Gliddol prevents the formation of any precipitate in leaded and unleaded gasoline—retards deterioration on exposure of the fluid to sunlight. Gliddol R, a special Gliddol product, slows up the darkening of fuel oil and reduces the formation of precipitate in the presence of heat.

Expert guidance on the use of Gliddol and Gliddol products to improve your product is offered without obligation by the Technical Service of Glidden — Pacemaker in Soya Research. Your inquiry is invited.

QUALITY Glidden PRODUCTS

The Glidden Company
SOYA PRODUCTS DIVISION
5165 West Moffat Street
Chicago 39, Illinois

15—Cycling Jet Pump



A two-part cycle, automatically continued until the pump is turned off, enables the Penberthy Cycling Jet Pump to lift by suction and discharge against heads approximately equal to the gas, air, or steam pressure used. Pump consists of a receiver tank, float-controlled operating valve, ejector, and necessary piping, gages, and valves. When the pump is turned on with the receiver empty, the float is in the lowest position. The air, gas, or steam is directed into the ejector, creating a vacuum in the receiver. Liquid to be pumped is thus drawn into the receiver. As this vessel fills, the float rises, ultimately closing the control valve to divert gas pressure from the ejector to the receiver. This then forces the liquid out. When the receiver is empty the float again actuates the ejector and starts a new cycle. A two inch size is available from stock. Penberthy Injector Co.

16—Pressure Controller

Increased accuracy in control of diaphragm motor valves is said to be available through the use of McAlear's No. 1500 Pilot pressure controller. It is recommended for pressure reduction, back pressure, pressure relief, vacuum, vacuum relief, pump governor regulation, and boiler fuel governor. The increased accuracy is reportedly due to a sensitive helix spring instead of the conventional "C"-gauge spring. Hysteresis is almost entirely eliminated. McAlear Mfg. Co.

17—High-temperature Insulation

A complete line of high temperature insulation products is now offered by Bigelow-Liptak, who in the past has supplied insulation only as a component part of its arches, walls, and furnace enclosures. A mineral wool block called BL-17 is available in standard sizes for temperatures to 1700° F. It has a density of 1.67 lbs./board ft. C-18, a companion product, is an insulating cement, effective to 1800° F., and containing a rust and corrosion inhibitor. Applied like a plastic 100 lbs. of C-18 will cover 50 to 55 board ft. It is reclaimable. Other products include an insulating cement good to 2300° F. Bigelow-Liptak Corp.

More "What's New!" Items, p. 1144

THE SARGENT VISCOSIMETER BATH *for Kinematic Viscosity Measurements*

The Sargent viscosimeter bath has been in general use, in its essential form for more than ten years and because of the soundness of its design, the present stock differs only in minor refinements from the original models.

Precision of automatic temperature control in the Sargent bath is actually, at least as good as its rating of ±0.02° F. and in order to attain this degree of efficiency we believe an oil bath must have the following essential factors.

1. **Lagless heaters** formed of heavy gauge chromel helices directly exposed to the oil.
2. **A high rate of circulation** using directed turbine flow.
3. **Variable input** to the permanent and intermittent heaters, such that the steady heat supply can be set to compensate the greater part of the steady rate of heat loss, leaving a minimum wattage to be applied by the intermittent heater, as the cyclic correctional increment.
4. **Double walled container.**
5. **Thermoregulator** of the maximum sensitivity compatible with serviceability characteristics.

The proper balance of these factors makes the Sargent viscosimeter bath the only bath which we are certain is capable of the rated precision when using oil as the bath medium and operating in the vicinity of 210° F.

Specifications:

Range: to 210° F.
Dimensions: Inner jar diameter 10", depth 10"
Outer jar diameter 12", depth 12"
Precision: 0.02° F.
Maximum Power Consumption: 1200 watts.

S-83255 VISCOSIMETER BATH—Oil, Constant Temperature High Precision 0.02° F., Sargent (Patent No. 2,037,995). As described, for use from 115 volt 50/60 cycle A.C. circuits..... **$230.00**

SARGENT

SCIENTIFIC LABORATORY EQUIPMENT AND CHEMICALS
E. H. SARGENT & COMPANY, 155-165 EAST SUPERIOR ST., CHICAGO 11, ILL.
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Freedom of choice
WITH R-C dual-ability
CENTRIFUGAL
One of a battery of three type H, multi-stage R-C Centrifugal Blowers; each direct-coupled to 700 HP motor; capacity of each blower is 15,000 CFM.
H-186-A
ROTARY
R-C Rotary Positive Blower, variable speed, 400/200 RPM; capacity is 12,000 CFM.
1135

You're not confined to just one type of blower or exhauster when you bring your air or gas handling questions to us. That's because we build both Centrifugal and Rotary Positive units. You can specify the equipment best suited to the specific job. We are the only blower manufacturer offering this *dual choice.*

R-C *dual-ability* delivers other advantages. Our extensive lines of Centrifugal and Rotary Positive types enable you to match capacities, pressures and other characteristics closely to your requirements—resulting in economies both in first cost and in operating cost.

You can bank on the performance of R-C Blowers, too. Building equipment for handling air and gas has been our only business for almost a century—so we *must* give complete satisfaction to every customer.

ROOTS-CONNERSVILLE BLOWER CORPORATION

910 Texas Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE BLOWER BUILDERS R-C SINCE 1854

BLOWERS • EXHAUSTERS • BOOSTERS • LIQUID AND VACUUM PUMPS • METERS • INERT GAS GENERATORS

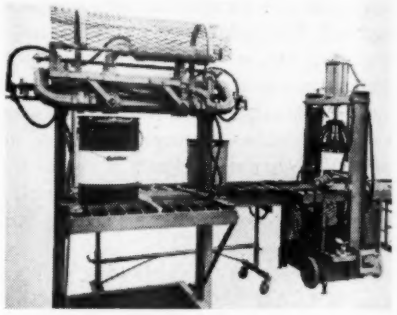
★ ★ ONE OF THE DRESSER INDUSTRIES ★ ★

What's New!

18—Cutting Oil Additive

Given a temporary name, "AE-1", a new Monsanto high molecular weight alcohol product is said to have high potentialities as a chemical intermediate in petroleum additives, particularly those for cutting oils and anti-wear oils. It is also expected to find use as a resin modifier in bituminous and asphalt type compounds, as well as in chlorinated rubbers, protective coatings, adhesives, etc. Monsanto Chemical Co.

19—Automatic Crimper



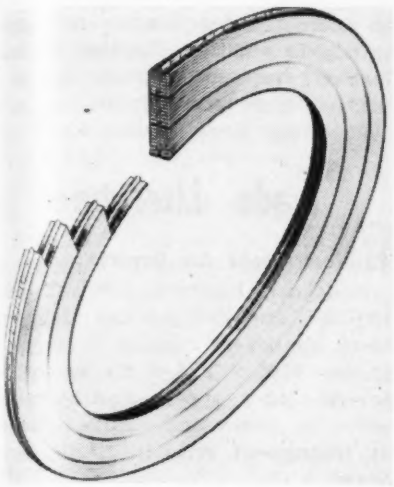
The installation shown in the photograph, a Barrett Filling Machine at the left, coupled by a conveyor with a Barrett Automatic Crimping Machine, enables a two-man crew to fill, seal, and stamp up to 15 five-gal. containers per minute of grease or other viscous products. One man feeds empty containers to the filling machine platform, designed to accommodate and fill two containers in rotation. A second man places a lid on each filled container and starts it down the conveyor ramp to the crimping machine, which requires no operator. It automatically centers the container under the crimping head, crimps it on with an air-tight seal, stamps on the batch number, and pushes the can down to the shipping point. Both machines are air-operated and portable. Barrett Mfg. Co.

20—Fire Extinguishers

The service life of Alfco Fire-Guns (vaporizing liquid type) has been doubled, it is stated, through use of a new tin plate process for the interior of the casing. New plating resists two forms of corrosion: by chemical acids formed if moisture enters the unit, and from electrolytic action. In addition, the plating reduces friction and makes manual operation easier. Fire-Guns are supplied in two sizes—1 and 1½ qt. American LaFrance-Foamite Corp.

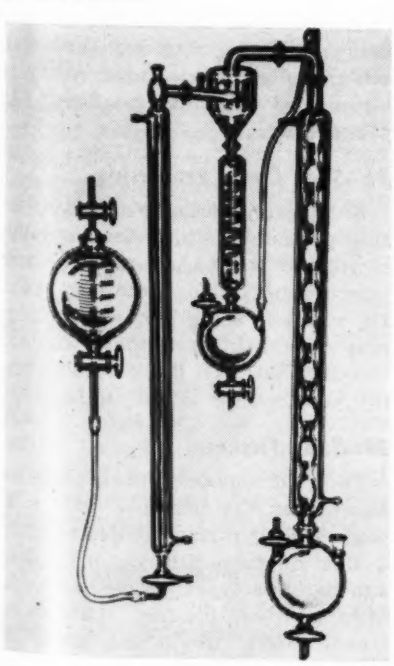
What's New!

21—Flexible Metal Gasket



A new flexible, all-metal gasket for high pressure and high temperature applications is said to be ideally suited for those cases where high temperature and the permeability of confined materials limits the use of asbestos or other soft fillers. Using a spiral-wound design, and several types of ferrous and nonferrous metals in combination, the product is said to possess the qualities of solid metal without its usual rigid characteristics. Flexitallic Gasket Co.

22—Evaporator



An all-glass Flash Evaporator, expressly designed for the laboratory, operates in principle in the same manner as industrial and pilot plant

More "What's New!" Items, p. 1146

USE STRONG* STRAINERS
-for *better* protection!

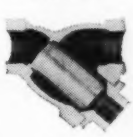
For steam, air, water and gas. STRONG'S new "Y" type strainer is ideal for the protection of steam traps, reducing valves, temperature controls, air control equipment, pumps, etc.

A HIGH-QUALITY, LOW-COST STRAINER!

★ **Monel Screen**—Mesh cloth in sizes ¼" to ⅜", larger sizes standard with .027 perforations. Self-centering guides prevent crushing.

★ **Semi-steel Body**—For rugged service. Sizes ¼" to 2". For steam pressures to 250 psi, cold pressures to 400 psi.

★ **Easy Installation**—New V-shaped gripping lugs on inlet and outlet bosses—may be easily installed with any type wrench.



CAST STEEL "Y" STRAINER

Available for pressures to 600 psi, screwed and flanged. Sizes ¼" to 4".

*Reg. Trade Mark

STRONG, CARLISLE & HAMMOND COMPANY

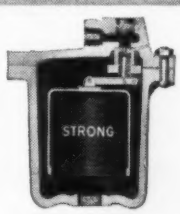
REG TRADE MARK

1392 West 3rd Street
Cleveland 13, Ohio

ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

No. 070 Small Trap



80 Series Trap

"T" Type Strainer

STRONG

National PRESSURE VESSELS

meet exacting codes and requirements for

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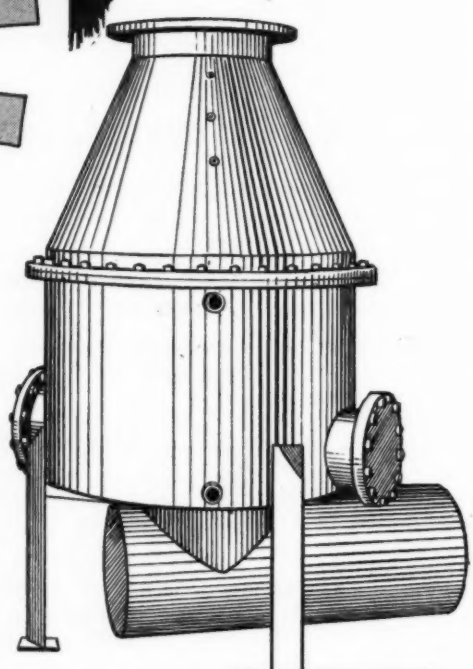
REFINERIES

STEEL INDUSTRIES

made to specifications from

- OPEN HEARTH
- STAINLESS
- STAINLESS CLAD
- NICKEL
- NICKEL CLAD
- ALUMINUM

When you specify National pressure vessels . . . you place your requirements in the hands of an experienced organization . . . capable of fabricating the most intricate industrial and processing equipment. Our modern manufacturing facilities and labor-saving production methods, assure you of prompt service in the construction of pressure vessels that meet exacting codes and requirements.



Hydrogen Vent and Seal Tank
5'6½" x 45" O.D.
Plate Thickness ¼"

NATIONAL PRODUCTS

- Pressure Vessels
- Galvanizing Kettles
- Annealing Covers
- Tin Pots
- Salt Annealing Pots
- Wire Annealing Pots
- Special Welded Tanks

National
ANNEALING BOX COMPANY
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long tube or film-type evaporators. It is operated under reduced pressure to lower the temperature of evaporation. In addition, the time of contact at evaporation temperatures is very short, reducing decomposition of heat levels. Emil Greiner Co.

Trade Literature

23—Instrument Air Dryers

Pritchard Hydryers, Bulletin No. 16.0.080; describes a series of instrument air dryers ranging in capacity to over 1100 SCFM of air, as well as several other types of dehydration units for gases and liquids. **Shown at Instrument Exhibit.** J. F. Pritchard & Co.

24—Remote Tank Level Gage

Varec Electronic Gauger: an 8-page booklet with descriptions and diagrams of method of operation of a device for remote reading of liquid level from as many as 24 typical petroleum storage tanks. **Shown at Instrument Exhibit.** Vapor Recovery Systems Co.

25—Infra-red Analyzer

The MSA "Lira" Infra-red Gas and Liquid Analyzer, Bulletin No. DZ-4: a description of the principle of operation, with a diagram, of a recording instrument adaptable to metering, for example, propane and butane in natural gas, the efficiency of a refinery gas reforming unit, and many other applications. **Shown at the Instrument Exhibit.** Mine Safety Appliances Co.

26—Sour Crude Processing

Kelloggram, Issue No. 4, 1949 Series, presents methods for controlling corrosion in major refinery units where sour crude containing 1.5 to 2% sulfur is being handled; including uses of both metallic alloys and nonmetallic materials like ceramics, plastics, and others. M. W. Kellogg Co.

27—Tube Fittings

Tube Fittings and Tube Fabricating Equipment, Catalog No. 203; a 56-page booklet giving complete data on a line of tube fittings, both flared and flareless types, as well as flaring tools, cutters, benders, mandrel extractors, side angle indicators, etc. Parker Appliance Co.

28—Valve Prices

Farris Discount Sheet for Catalog No. 48, announces a new price reduction on bronze and iron safety-relief valves. Farris Engrg. Corp.

What's New!

29—Spiral-weld Pipe

Taylor Spiral-Weld Pipe, Bulletin 493; announces the availability for prompt delivery of this type pipe from plants in Carnegie, Pa., and Fontana, Calif.; giving sizes and wall thicknesses, and typical applications. Taylor Forge & Pipe Works, Inc.

30—Instruments and Valves

Ratomatic Instruments, Catalog 50; 24 pages on instruments for remote indicating, controlling, and totalizing of fluid flow; including air-operated controllers, valves, proportioners, typical installations, tables of dimensions and specifications. Fischer & Porter Co.

31—Refractories

Mullitex Refractories; booklet covering fire brick and refractory materials, with properties, applications, and other details in tabulated form for convenient reference. Walsh Refractories Corp.

32—Caustic Soda

Caustic Soda, a new edition of Technical and Engrg. Service Bulletin No. 6; 80 pages of information on properties of caustic soda and its solutions, plus the most recent data on its unloading and handling; illustrated with photographs, tables, graphs, and diagrams. Solvay Sales Div., Allied Chemical and Dye Corp.

33—Flue Gas Analyzer

The Engelhard CO_2 Analyzer, Bulletin 710; four pages covering an analyzing and recording instrument using the thermal conductivity principle, and how it can be used to improve combustion efficiency in boilers and furnaces by checking carbon dioxide content and the temperature of stack gases. Charles Engelhard, Inc.

34—Tube Expanders

Wilson-Dudgeon Tube Expanders, Bulletin 420: a six-page folder giving data on expanders for condensers, heat exchangers, and general small tube rolling, a line of assembly tools and wrenches, and tube cleaners. Thomas C. Wilson, Inc.

35—Instrument Catalog

H-B Catalog 15: a 40 page booklet covering complete line of thermometers, psychrometers, barometers, and hydrometers, including thermometers in the ASTM standards for testing of petroleum and its products; with cross indexing, and current price list. H-B Instrument Co.

More "What's New!" Items, p. 1148

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Gives Accurate Readings Instantly

High resistance per millivolt in this self-contained, portable precision instrument gives you extreme accuracy, regardless of thermocouple resistance or length of connecting lead. Readings in either millivolts or degrees are instant, because of the direct deflection principle employed. Graduated with either 100 or 200 divisions on a 6-inch scale—or furnished with two scales calibrated for various thermocouple combinations. Engelhard frictionless galvanometer eliminates pivots, bearings or other wearing parts. Does not require experience to handle—no manual adjustments. For complete information, just fill out coupon below.

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CHARLES ENGELHARD, INC.
850 PASSAIC AVENUE, EAST NEWARK, N. J.

36—Corrosion-resistant Alloys

Special Alloys for Industry, Resisting Corrosion, High Temperatures, Abrasion; Bulletin No. 4729-G: 16 pages on a series of chrome-nickel and chrome-iron alloys in static castings, from 1 oz. to 12,000 lbs., and in centrifugally cast tubes, from 2½ to 24 in. diameter. The Duraloy Co.

37—Expansion Joints

Engineered Bellows Type Expansion Joints, Catalog 50: 20 pages giving description, dimensions, and specifications on a line of expansion joints, turbo joints, anchor joints, offset joints, and the like; including a table of thermal expansion of pipe in inches/100 ft. Magnilastic Div., Cook Electric Co.

38—Plug Valve Lubricant

The Flow Line, Vol. 8, No. 5, Sept.-Oct., 1949; 20 pages devoted to the new compressible plug valve lubricant, Hypermatic, said to eliminate leakage and reduce maintenance costs as much as 90%; Nordstrom Valve Div., Rockwell Mfg. Co.

39—Gas Absorption

Agitated Gas Absorbers; a reprint of a paper by K. S. Valentine; discussing the processes for which gas absorption apparatus of the mechanical agitator type are best suited. Patterson Foundry & Machine Co.

40—Water Pumps

Oil-Lubricated Pumps, Bulletin 1013, and *Water-Lubricated Pumps,* Bulletin 1014: describe with sectional drawings showing component parts, methods of operation of Johnston turbine pumps for every type of water transfer problem. Johnston Pump Co.

41—Water Treatment

Elgin Water Conditioning, Bulletin 610; 20 pages of information on design and application of water conditioning equipment, including zeolite softeners, treating chemicals, conditioning systems for boilers and processing, filters, aerators, etc. Elgin Softener Corp.

42—Automatic Blowdown

Complete Automatic Control of Boiler Water Concentration Without Heat Loss; a four-page folder showing schematic arrangements for the use of a boiler blowdown system which is continuous, automatic, and under thermostatic control. Henszey Co.

43—Alloy Plug Valves

Durco Types A & B Plug Valves are covered in Bulletins 636, 637, and 638: valves range from ½ to 6 in. size in wide range of alloys; including Durimets, Chlorimets, nickel, Inconel, Monel, and Ni-Resist, and with Teflon diaphragms and packing seals. Duriron Co.

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For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 1137. Just circle the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

NEWS OF

Manufacturers—Suppliers—Engineering Firms

Serving the Petroleum Processing Industry

Fluor to Lincense SASCO Processes

Fluor Corp, Ltd., Los Angeles, announces the conclusion of an agreement with Mathieson Chemical Corp., New York City, whereby Fluor becomes Mathieson's sole licensing agent for the engineering and construction of sulfur recovery plants in the U. S. and Canada. Plants engineered by Fluor will embody Mathieson's SASCO processes for the recovery of sulfur from hydrogen sulfide gas, acid sludge, and similar refinery waste products.

According to the agreement, Mathieson will grant licenses for the use of its sulfur recovery processes only to those firms nominated by Fluor and will supply the necessary technical information and technicians to assist in the design and operation of plants licensed under the agreement. Fluor will be employed to construct those sulfur recovery plants which Mathieson will require for its own use and will be recommended for the construction of similar plants to be owned by others.

Cochrane Names Division Manager

Samuel B. Applebaum has been named manager of the Cold Process Water Treating Division of Cochrane Corp., Philadelphia. He is also vice president of the Liquid Conditioning Corp., an operating subsidiary of Cochrane, whose capital stock they purchased in February, 1949. Mr. Applebaum was formerly vice president of Permutit Co. and later president of Liquid Conditioning Corp.

Cooper Alloy Holds Contest

To stimulate interest in existing applications for cast stainless steel and to encourage progress in the battle against corrosion, Cooper Alloy Foundry Co. has announced the first of a series of essay contests, for which it will offer cash and prize awards totalling over $5000 for the best technical papers. It is intended to cover the major fields of application, including: chemical, petroleum, food, etc.

Papers are now being accepted for the first contest, dealing with "Applications for Cast Stainless Steel in the Chemical Industry". Date limit is May 1, 1950. Rules and other information for the other proposed contests will be announced at a future date. Complete details may be obtained by writing Cooper at Hillside, N. J., attn.: Contest Editor.

Hammel-Dahl Expands in Southwest

Horace A. Thompson, Jr., has been appointed a dealer for Hammel - Dahl Co., and will represent their line of automatic control valves in central and eastern Louisiana, southern Mississippi, and northwestern Florida. Mr. Thompson formed the Thompson Equipment Co. of New Orleans in 1945, following his release from military service, and is specializing in chemical and petroleum processing instruments. A chemical engineering graduate of Tulane in 1938, he was associated with Esso Standard Oil Co. until joining the Marine Corps in 1941.

Professor Joins Santa Fe Tank

N. W. Snyder, assistant professor of mechanical engineering at the University of California, has joined the staff of Santa Fe Tank & Tower Co., Los Angeles, as chief technical consultant. Dr. Snyder will work in conjunction with L. Obert and A. M. Kuehmstad, veteran members of the Santa Fe engineering staff, on an extensive program in cooling tower research and development. He has been in charge of a large project of this nature at the University.

Kieley & Mueller Extends Sales Area

Kieley & Mueller, Inc., North Bergen, N. J., is expanding its sales activities in automatic process control instrumentation in the Pacific Coast area with the appointment of three new sales representatives.

In Southern California, sales will be under the W. J. Beckett Co., 108 West 6th St., Los Angeles. William Beckett, head of the company, has been associated with Hanlon Waters Co. (now Climax Engrg.), Fluor Corp., and Bushnell Controls, from which post he resigned in 1948 to form his own firm.

Northern California will be handled by Hugh Rodman, with offices at 270 Fremont St., San Francisco. Mr. Rodman was for many years associated with Universal Oil Products Co. and more recently with Bushnell.

The Northwest Pacific area will be covered by Farnes & Martig, Inc., at 417 N. E. Couch St., Portland, and at 422 Smith Tower, Seattle. In addition to the heads of this company, Bert W. Farnes and Robert W. Martig, the staff includes Grant C. Edgel, John C. Morton, and Ray E. LeRiche.

Mac Watt Joins Koven

L. O. Koven & Brother, Inc., has announced the appointment of Kenneth H. Mac Watt as director of engineering sales. He succeeds W. D. Birch, who resigned recently. A graduate of Stevens Institute in 1931 in mechanical engineering, Mr. Mac Watt was first employed by Tide Water Associated Oil Co. He then joined Alco Products Division of American Locomotive Co. where he was concerned with engineering problems in the manufacture of oil refinery equipment. He will make his headquarters at Koven's home offices in Jersey City, N. J.

Hercules Supply Incorporates

Hercules Supply Co., 6900 Clinton Drive, Houston, after almost 30 years has become a corporation and added two prominent men in the industry as part owners, officers, and directors. They are J. W. Elizardi, Jr., formerly a vice president of Griscom-Russell Co., and J. E. Finch, formerly a vice president of Plowden Supply Co.

Mr. Elizardi, a vice president of the new corporation, will continue to represent a large list of customers in

the Southwest for Griscom-Russell. Mr. Finch, also a vice president of the new corporation, will be in charge of industrial supply sales. J. T. McCarthy, Jr., founder of Hercules, is president of the corporation, a supplier of refinery, gasoline plant, oil well, and pipe line supplies.

Expansion, Transition

Graver Water Conditioning Co., a division of **Graver Tank & Mfg. Co.**, has announced the removal of its general offices to larger quarters at 216 West 14th Street, New York 11, N. Y. The new location houses expanded sales and engineering offices, a complete chemical laboratory, and an extensive pilot plant.

W. C. Hardesty Co., Inc., fatty acid producers, have completed construction of a new type hydrogenation unit at the Los Angeles plant. The process used is selective hydrogenation, utilizing fatty acids instead of the commonly used glycerides. A feature of the installation is that its source of hydrogen is dissociated anhydrous ammonia.

With the acquisition in September of the business and assets of the **Crocker-Wheeler Division** of **Joshua Hendy Corp., Elliott Co.** now has a complete line of AC and DC electric motors ranging in size from one to 25,000 hp. Formerly, the Elliott line did not include motors under 200 hp. The Crocker-Wheeler plant is located at Ampere, N. J.

Research Corp. announces that the **Niagara Blower Co.** has been awarded the license to manufacture dehumidifying and air conditioning equipment under its series of patents covering the removal of moisture from air or other gases by the use of a hygroscopic liquid.

John Nooter Boiler Works Co., St. Louis, became known as the **Nooter Corp.**, effective October 1. Organized in 1896, the firm specializes in the construction and fabrication of vessels for petroleum and chemical processing.

Magnolia-Airco Gas Products Co. now carries on the business formerly conducted by the **Air Reduction Sales Co.** in the southwest. Magnolia-Airco has opened a new oxygen plant in Hobbs, New Mexico, with William Bowhay as plant superintendent. The plant will serve also as an acetylene warehousing point.

A. O. Smith Corp. of Milwaukee has formed a new company, **A. O. Smith Corp. of Texas**, which will build and operate a plant in Houston, for manufacturing welded steel pipe. It will have a capacity of from 30,000 to 35,000 tons of pipe per month. Line pipe to be manufactured will range in diameters down to 8⅝ and up to 30 in. and larger if required, and will be fabricated in uniform lengths of 40 ft. The plant will be located adjacent to the present Houston works of A. O. Smith Corp., and also adjacent to Sheffield Steel Corp., which will provide most of the steel. Cost of the mill is estimated in excess of $5,000,000. Completion is expected by summer, 1950.

Personnel Changes

Elliott Co.—Charles A. Butcher has been elected a vice president, effective Sept. 16. He will continue to function as general manager of Crocker-Wheeler Electric Mfg. Co., a recently acquired division of Elliott.

Fitzgibbons Boiler Co., Inc.—Milton O. Lange, formerly special sales rep-

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FOR MORE COMPLETE INFORMATION, REQUEST A CATALOG.

Precision SAYBOLT VISCOSIMETER

This new, constant temperature, trouble-free Viscosimeter of 2 or 4-tube capacity, is for use according to A.S.T.M. Method D-88. Entirely self-contained, it is built for continuous duty and is safe from fire hazard. Combining a new measure of ease, consistent accuracy, and absolute dependability, this Viscosimeter will aid the operator by releasing his attention from "mechanics" and will promote both speed and accuracy.

Bulletin 705A contains complete information. Get your copy today.

Precision Scientific Co.

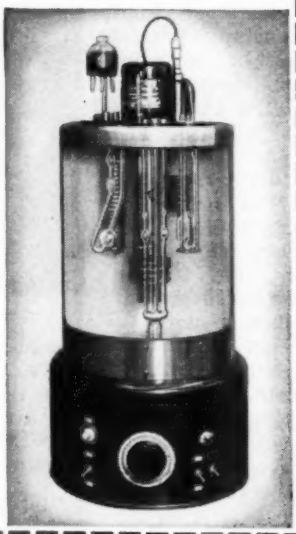
Precision MODEL S KINEMATIC VISCOSITY BATH

This Viscosity Bath is for Kinematic Viscosity determination with Ostwald, Ubbelohde, or other suspended level viscometers commonly used in A.S.T.M. Method D-445 or A.A.F. Specification 3608.

- 6-Tube Capacity.
- Temperature range from 70°F. to 212°F.
- Sensitivity ±0.25°F.
- Octo-Mix Tubular Stirrer.

For the complete story on this Viscosity Bath ask for Catalog 705A1.

Precision Scientific Company



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resentative for Joseph T. Ryerson & Son, Inc., has been appointed manager of Plate Product Sales for Fitzgibbons. While with Ryerson, he was responsible for the sale and production of numerous fabricated steel products used in TCC units at Tide Water Associated Oil Co., and the catalyst bead plant of Socony-Vacuum Oil Co., Inc.

Fritz W. Glitsch & Sons, Inc.—Robert L. Allen has been promoted to district manager at the newly established office in Cleveland, serving Ohio, Pennsylvania, upper New York and eastern Michigan. Allan Persson, formerly in the Dallas plant of Glitsch in tray and cap design, has been appointed manager of the Chicago office, to replace Mr. Allen.

Ansul Chemical Co. — C. Victor Mars, former sales manager of the Industrial Chemicals Division, has been named manager of the New Product department. Robert J. Yaeger succeeds him as Industrial Chemical sales manager. In his new post, Mars will co-ordinate work in the development of new uses for sulfur dioxide and methyl chloride as well as new products based on these chemicals.

Lukens Steel Co.—John H. Faunce, Jr., for the last three years district sales manager at the Chicago office, has been named manager of sales promotion, with headquarters in Coatesville.

Builders Iron Foundry, and its associated companies, Builders-Providence, Inc., Proportioneers, Inc., and Omega Machine Co., has announced the promotion of Earl H. Bradley to executive vice president and Irving O. Miner to vice president. Mr. Bradley formerly was vice president and Mr. Miner, chief engineer.

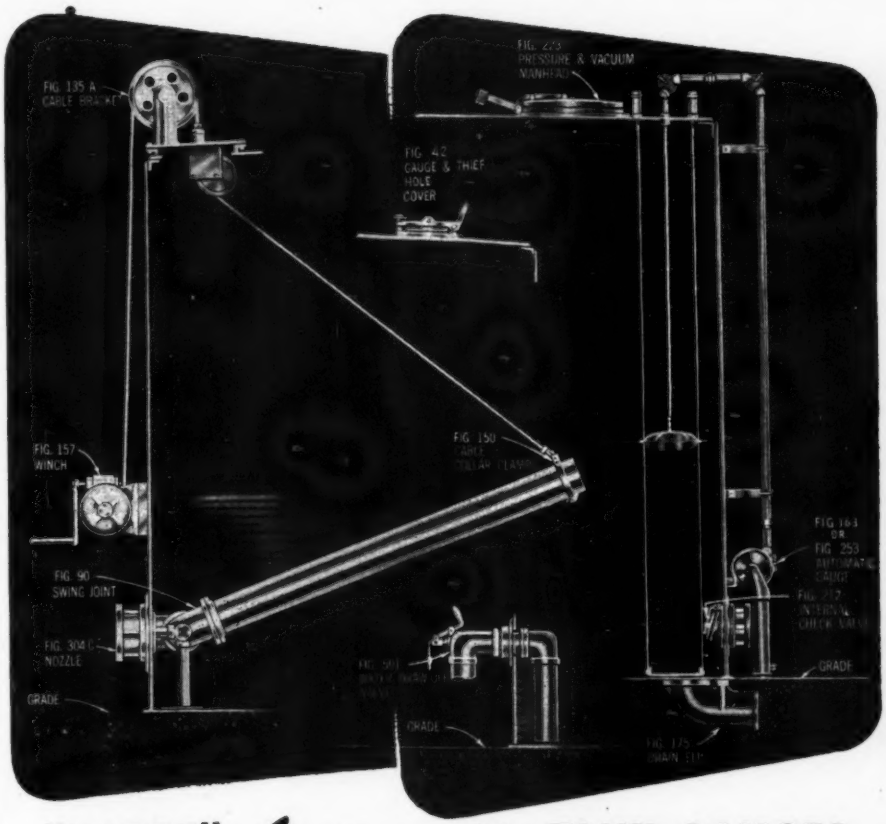
Cooper Alloy Foundry Co. has appointed **Wm. G. Boales & Associates,** Detroit, as Michigan representatives. Boales will handle the Cooper line of stainless steel valves, fittings, accessories, and castings.

Davison Chemical Corp.—Dr. Paul W. Bachman has been appointed manager of the newly formed department of development planning. He will act as liaison for research, operations, and marketing divisions.

Specialized Instruments Corp.—K. Kennard Gross, previously co-ordinating engineer with Leeds & Northrup, has been named eastern service engineer for Spinco Ultracentrifuges made by this Belmont, Calif. concern. He will make his headquarters in Philadelphia.

ACCURATE and RELIABLE

TANK ACCESSORIES
for *Convenient* Operation



"VAREC" *Automatic* TANK GAUGES
and SWING LINE EQUIPMENT

Designed for all types of tanks and corrosive conditions, VAREC Automatic Tank Gauges afford you a safe, accurate, economical means of measuring liquid levels . . . conveniently, and as often as necessary. Gauges operate on a float actuated tape; give reliable readings in an eye-level lookbox outside the tank.

VAREC Swing Line Equipment is especially designed to provide a rapid, convenient method for withdrawal of liquids at various levels. Essentially, it consists of winch and swing joint for raising and lowering of a standpipe.

VAREC gauge hatches, water drawoff valves, drain ells, internal check valves, etc. will safely and reliably complete your tank installation. *Check your needs today.*

CP-12

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Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

Answers to the questions presented regularly here are supplied through the co-operation of authorities with the equipment and engineering companies of the Natural Gasoline Supply Men's Assn., among others. Readers are invited to submit queries on plant operating problems in their own work.

Proper Ink Necessary For Legible Meter Charts

What can be done to assure clear and legible chart records for recording instruments?

The full value of instrument chart records can only be realized when due importance is placed on the service conditions which affect the production of clear and legible records. Type of ink, paper finish, chart speed, rate of pen travel and contamination of the ink in the pen all are factors which must be considered.

Recorder inks are specifically designed for service requirements, particularly with respect to the type of chart paper. For the heavier, hard surface papers, such as supplied on most circular chart recorders, the ink contains glycerine. This results in slower drying, so that it tends to penetrate the paper and not run or smear on the surface. For thinner papers, such as furnished on strip chart recorders, the ink is designed to evaporate quickly so that it does not produce a feathery or "torn" chart record.

The difference in ink formulas to suit the chart paper indicates the need for careful matching of inks to chart paper. Utilizing slower drying ink on the thinner strip chart paper or, conversely, the quick-drying ink on the heavier circular chart paper only increases the difficulties the inks are designed to overcome. Proper identification of ink supplies in the plant is of vital concern to assure their proper use.

Another circumstance which can frequently result in unsatisfactory records is field contamination of pens. Many substances, such as soaps, oils or solvents, have a highly deleterious effect on the quality of the record. Only a minute trace of such foreign material in a pen can cause deep penetration, feathery records or clogging of the pen. It is important to note that pure water is the safest cleaning agent.

Closely associated with these is the matter of mixing different types of inks. A pen never should be refilled with another type ink unless the pen is carefully washed clean of all traces of the old ink.

Combined with the use of high grade chart paper, checked and tested by the instrument factory for strict adherence to specifications, the precautions outlined should result in satisfactory chart recordings.— E. M. Kramer, Minneapolis - Honeywell Regulator Co., Brown Instruments Division, Philadelphia.

Acid-Resistant Gunite For Cooling Tower Basin Repairs

What formula of "gunite" mix is recommended for repairing concrete cooling tower basins (see Petroleum Processing for November, 1948, page 1055) subject to localized high concentrations of water treating acid?

We would recommend "Lumnite" cement made by the Universal Atlas Portland Cement Co. for use where the water is apt to become highly acidic at times. The "gunite" mix consists of one part of "Lumnite" cement to three parts of good, clean, well-graded silica sand, with finish to be natural as originally applied by the nozzle of the cement gun.

Generally speaking, regular Portland cement costs $1 per sack while the average cost of "Lumnite" cement is $3. The "Lumnite," in addition, must be cured by continuous sprinkling with water for approximately 16 hrs., beginning about 4 hrs. following aplication by the gun. This may require the payment of an appreciable premium labor cost for the extra time involved.

While the "Lumnite" mix therefore will cost more than the normal "gunite" mix and involve additional workman's time in the curing, other costs are the same as for the usual "gunite" job. Considering the special acid resistant qualities of the "Lumnite" mix as compared to the very low acid resistance of the normal gunite mix, these additional costs will not be excessively greater under the circumstances.

Preparation of the damaged cooling tower basin for guniting with the "Lumnite" mix is the same as set forth in the answer to the earlier question cited above.—B. A. Greene, Gunite Concrete & Construction Co., Kansas City, Missouri.

Protecting Compressors From H_2S Corrosion

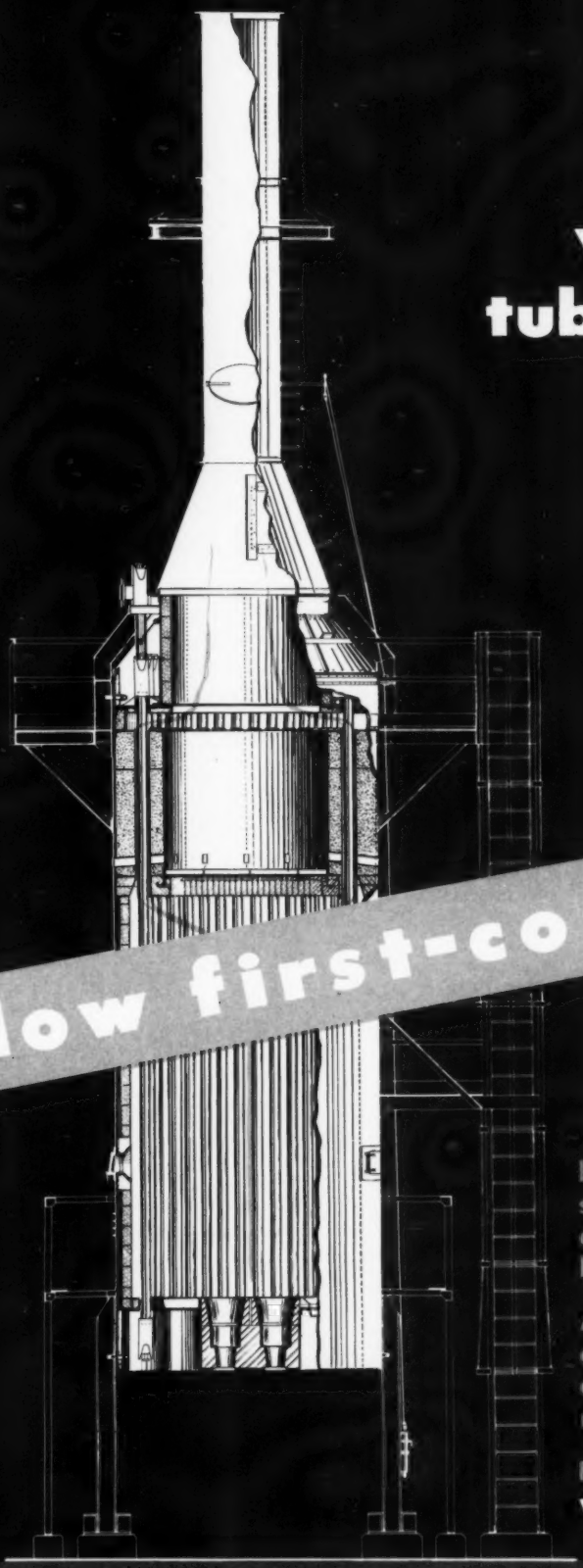
What protective measures can be installed to protect the fluid end of a compressor against corrosion from gas containing hydrogen sulfide? Will these measures also apply to the engine side, if the fuel gas likewise is sour?

Hydrogen sulfide is a poisonous gas quite difficult to handle. Uniting with oxygen and water, it forms acid which will attack most known metals. Unfortunately, gas from many fields contains varying quantities of this harmful substance and there is no known inexpensive method for its complete removal prior to the fluids' entrance in handling equipment. Compressor manufacturers design equipment using metals less subject to attack by hydrogen sulfide in order to minimize maintenance.

The following materials and precautionary measures are recommended for gas engine-driven compressors handling gases containing hydrogen sulfide:

Compressor End

Low Compression Ratio. Keep the compression ratio per stage as low as possible. High compression ratios are attended by correspondingly high discharge temperatures, which, together with hydrogen sulfide, accelerate wear and deterioration of the discharge valves. Furthermore, hydrogen sulfide tends to promote formation of polymers (gummy substances) which are deposited on the valves and impede operation. The rate of polymer deposition depends



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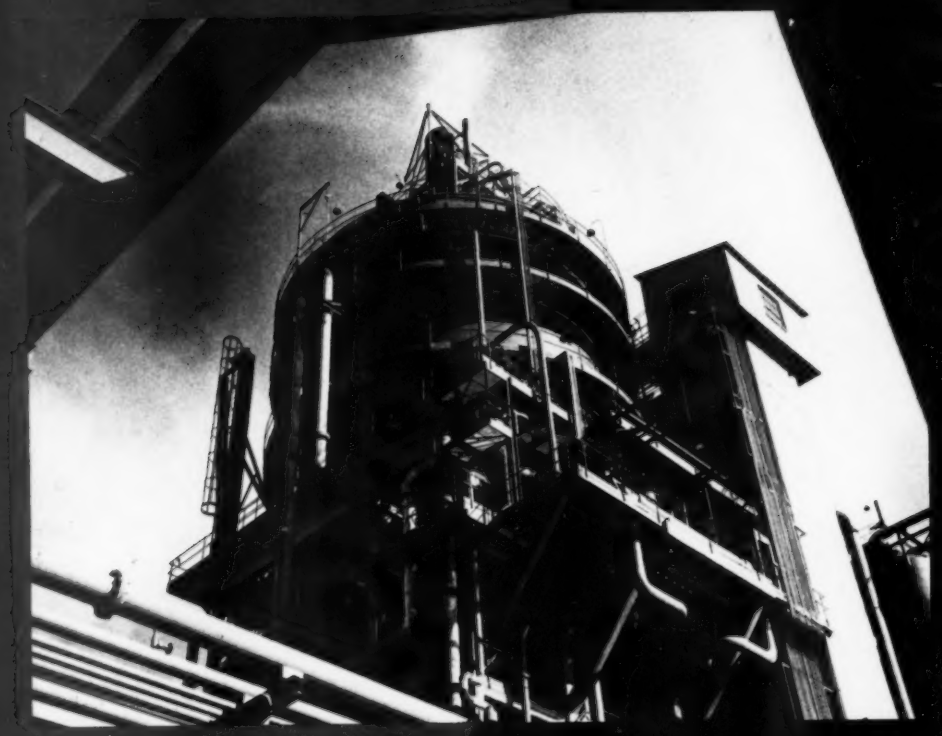

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upon the quantity of heavy ends in the gas and the discharge temperature, increasing as the discharge temperature increases.

Atmospheric Suction Pressure. It is important to keep the suction pressure above atmospheric to avoid air leakage into the system. Hydrogen sulfide, oxygen, and water vapor combine to corrode steel, cast iron and other materials. Corrosion becomes acute if care is not exercised to minimize air leakage in a system having less than atmospheric pressure.

High Hydrogen Sulfide Content. When hydrogen sulfide contents are high, a flushing oil system is recommended. In a system of this type, high gravity distillate or absorption oil which is not detrimental to the process is injected into the suction of each compressor cylinder. The oil washes the gummy substance from the valves and prolongs valve life.

Flushing oil should be used where the gas contains heavy ends and the hydrogen sulfide concentration is 1000 grains per 100 cu. ft. or greater. Approximately 5 qts. of distillate per hour per compressor cylinder are normally injected but this will vary, depending upon the amount of hydrogen sulfide present in the gas.

Materials for Compressor Cylinder Parts. The materials listed in Table 1 should be considered when compressing gas containing hydrogen sulfide. Although the gas may be purified by one of the many sweetening processes, nevertheless we recommend that these materials be used to obtain maximum compressor protection in event the purification system fails.

Power End

It is foolhardy to attempt to use fuel gas containing any great amount of hydrogen sulfide. The havoc sour gas causes when burned in power cylinders is too well known to permit its use. Unless the hydrogen sulfide is removed, down time will be great and maintenance costs excessive. Moreover, hydrogen sulfide causes pre-ignition and detonation which makes it difficult for the

TABLE 1—Corrosion Resistant Materials for Compressor Cylinder Parts

Part	Material
Valve Stop Plates	High Grade Cast Iron or Semi-Steel
Valve Discs	11-13% Chrome Steel
Valve Springs	Inconel or Music Wire
Valve Seats	18-8 Stainless Steel, High Grade Cast Iron or Semi-Steel
Pistons	High Grade Cast Iron or Steel
Piston Rings	Cookmet Bronze where gas is free of oxygen or moisture; otherwise Micarta
Piston Rod Packing	Cookmet Bronze where gas is free of oxygen or moisture; otherwise Micarta
Piston Rods	11-13% Chrome Steel

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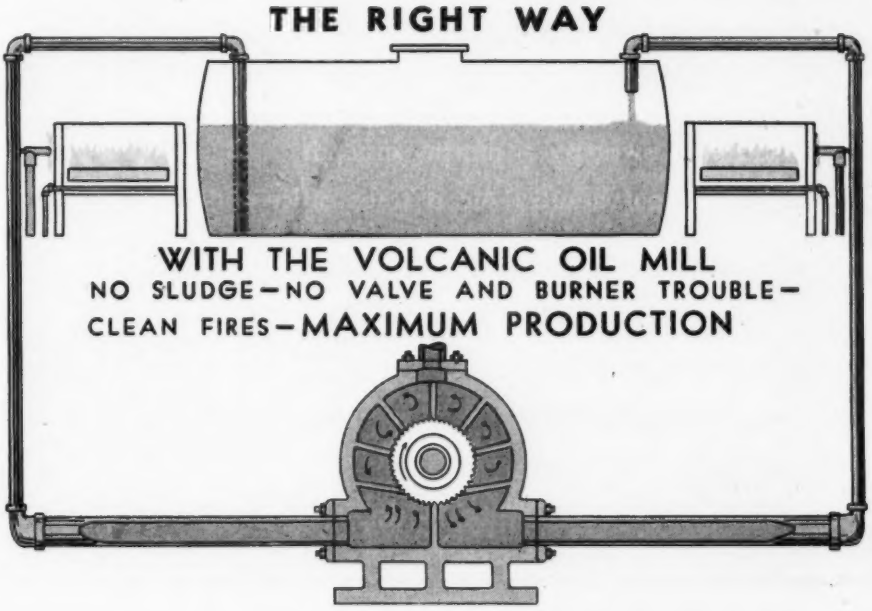

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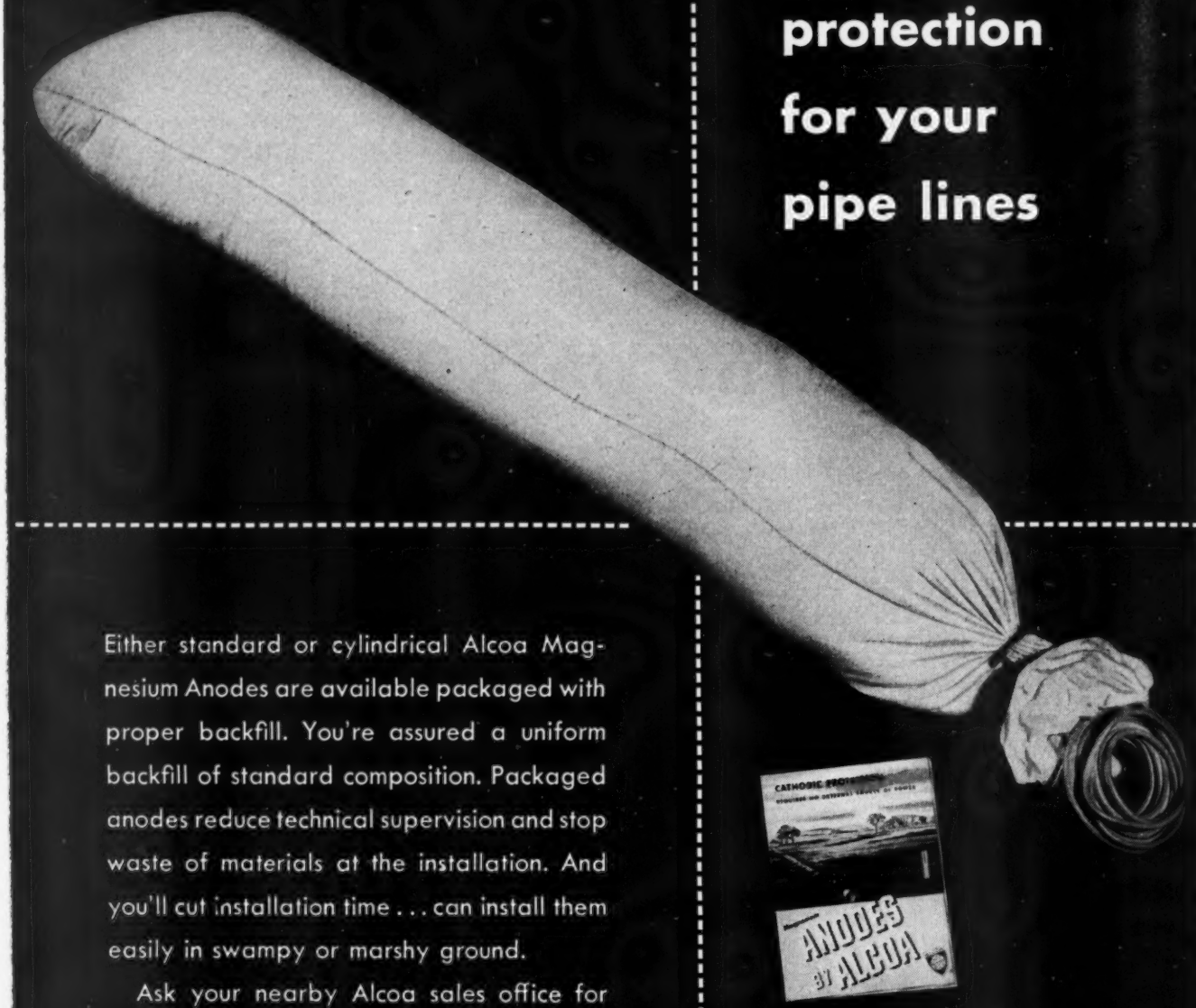

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engine to develop rated horsepower. The reserve horsepower usually built into the engine for emergency and overload conditions becomes non-existent. Because of these factors, engine builders do not deviate from the standard machine and, where a quantity of hydrogen sulfide is contained in the fuel gas, they definitely recommend scrubbing the gas to a maximum of 10 grains per 100 cu. ft.

The less hydrogen sulfide contained in the fuel gas, the better will be the engine performance. About the only alternative, in case the hydrogen sulfide is not removed, is to decrease the compression pressure and use aluminum asbestos gaskets. This is not considered satisfactory, however, for by so doing the overload pulling capacity is materially reduced.—Clark Bros. Co. Inc., Technical Service Dept., T. J. Chrzan, Manager; Jay B. Williams, Tulsa.

Oil Tar Sludge Formation In Internal Combustion Engines

What promotes the formation of oil tar sludge in an internal combustion engine?

The tarry kind of sludge, black and sticky, is attributed generally to the operation of the engine with oil at a high temperature. When the engine is operating at a high temperature, with oil temperature above the recommended maximum, the oil is decomposed, to a considerable amount of tar, among other things. This tar-like substance generally deposits on piston skirts, where its presence is indicated by a sticky, brownish discoloration. It often is black from the soot usually mixed in it. — Max E. Landry, Bruce-McBeth Engine Co., Tulsa.

Precautions Necessary When Metering Wet Natural Gas

An isolated gas well has recently been tied in to the line feeding our absorption plant. We are metering the gas at the well under a pressure of 800 lbs. per square inch, but are having difficulty with the meter. Apparently the well produces condensate, and this may be interfering with our measurements. Is it possible to meter a wet natural gas? If so, what precautions should be taken, and what procedure should we use for computing the deviation factor?

Wet natural gas may be metered satisfactorily without separating the two phases provided the analysis of the wet gas or its gas gravity is known. The average density of a wet gas may be computed by the same compressibility factor method that is used to estimate the density of a dry gas.(2) The relationships between liquid and vapor densities at temperatures above the critical temperature, and at pressures greater than approximately 1000 psi. are such that the presence of the liquid in quantities less than 10% by volume has no appreciable effect upon either the compressibility factor, $Z = PV/RT$, or the average density calculated as if there were no liquid present.(3) That is to say, if two gases of the same gravity are at identical temperatures and pressures within the limits stated above, and one gas contains 5% liquid while the other is dry; the densities of the two gases will be approximately equal, at least within the limits of accuracy of the compressibility factor charts.

If wet gas is to be metered accurately, the turbulence in the pipe must be sufficient to prevent "slugging" by insuring uniform suspension of liquid in the vapor stream.

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Questions and Answers

and so prevent "slugging". A flow rate of 1,500,000 standard cubic feet per day per inch of pipe diameter is recommended as the minimum flow rate for good metering. For the same reason this minimum flow rate is also required for accurate sampling.(1)

The flow rate may be computed by the following equation

$$Q = C\sqrt{\frac{1}{G}}\sqrt{\frac{520}{T_f}}\sqrt{\frac{1}{Z}}\sqrt{Ph}$$

where:

Q = cubic feet of gas flowing per unit time at 60° F. and a standard pressure such as 14.65 psia.

$\sqrt{\frac{1}{G}}$ = gas gravity correction factor where G is the gas gravity, or the ratio of the gas molecular weight to that of air, 29.0.

$\sqrt{\frac{520}{T_f}}$ = gas temperature correction factor to the flowing temperature, T_f, from the base temperature 60° F. (520° R.).

$\sqrt{\frac{1}{Z}}$ = the deviation factor to correct for the deviation of the gas from the ideal gas law where Z is the compressibility factor, (PV/RT).

P = the absolute pressure of the flowing gas in pounds per square inch.

h = the pressure differential across the orifice, inches of water.

C = the orifice coefficient, the value of which depends on the flow rate of gas, the units of flow, the orifice and pipe diameters, etc.

The densities obtained by this method my be trusted only within the stated limits. However, a correlation of correction factors for two-phase systems has been developed by E. B. Elfrink, C. R. Sandberg, and T. A. Pollard, of the Magnolia Petroleum Co. based upon compressibility measurements of 21 samples obtained from eight oil fields. The paper was presented at the February, 1949, meeting of the A.I.M.E. and will be published shortly. It is entitled, "A New Compressibility Correlation for Natural Gases and Its Application to Estimates of Gas-in-Place".—D. L. Katz and Brymer Williams, Dept. of Chemical & Metallurgical Engineering, University of Michigan, Ann Arbor.

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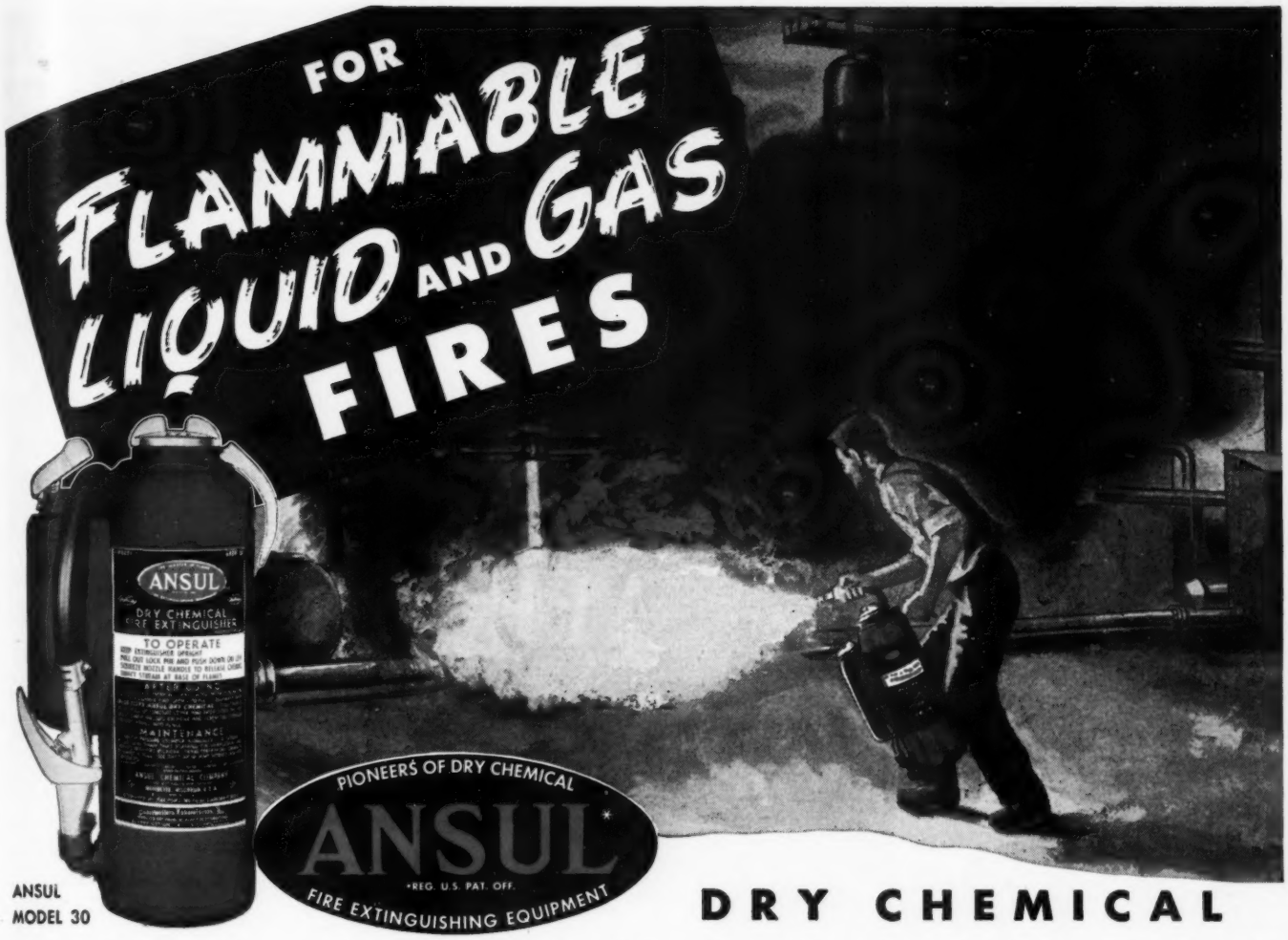
(1) Brown, G. G., and Katz, D. L., *Proc. Natural Gasoline Assn. of America*, 1945.
(2) Mathews, T. A., Roland, C. H., Katz, D. L., *Ref. and Nat. Gas. Mfr.*, June, 1942.
(3) Standing, M., and Katz, D. L., *Pet. Tech.*, July, 1941.



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REFINING TRENDS

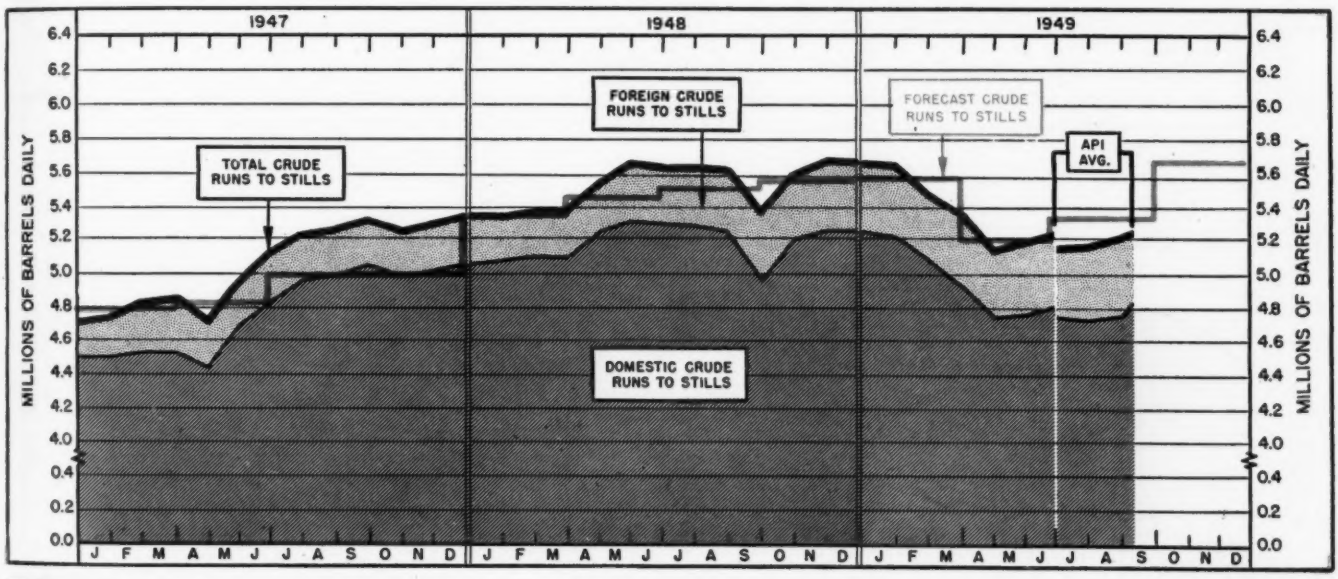
Demand for Distillate Begins to Rise

DISTILLATE fuels are showing the seasonal upward trend in demand, but demand is still under that of a year ago. Stocks of these products are about in line with stocks of a year ago, but may be subject to more than seasonal withdrawals when wholesalers and consumers rush to fill their storage if an early cold spell develops. Refiners are taking a total distillate yield of less than 20% from crude at present, the lowest in three years. This reflects the extent to which these stocks have been converted at refineries into gasoline, the only major product showing larger demand than a year ago, thus enabling refiners to operate on lower crude runs.

Motor fuel demand and production is ahead of a year ago. Reduction in stocks in the motoring season thus far (through August) is nearly 17 million barrels, while a year ago the reduction was 13 million barrels in the same period. Stocks at the end of August were about 10 million barrels higher than a year ago.

Refinery production of residual fuel oils in July and August was at a rate about 15% less than in the same months last year. Imports of residual fuel oils are materially higher, but the total supply is considerably less than a year ago. Demand for the two months was about 8% less than last year. Result is that residual stocks have accumulated at a relatively low rate this year and the total stocks volume is under that of a year ago.

Fig. 1—Domestic and Foreign Crude Run to Stills



Yields on Crude Run to Stills

(Bureau of Mines Data)

	Gasoline	Kerosine	Dist. Fuels	Res. Fuels
July, 1949, %.....	45.7	4.4	16.2	20.1
July, 1948, %.....	41.3	5.5	17.8	22.6
July, 1947, %.....	40.6	5.6	16.3	23.9

End-of-Month Inventories, Refinery Products, 1000 bbls.

	Gasoline	Kerosine	Distillate	Kerosine & Distillate	Residuals
Aug. 31, 1949 (API data).....	105,454	25,664	75,696	101,360	68,167
Aug. 31, 1948 (BofM data).....	95,445	23,564	68,818	92,382	71,839
Aug. 31, 1947 (BofM data).....	85,849	20,824	54,707	75,531	56,654

U. S. Refinery Operations, bbls

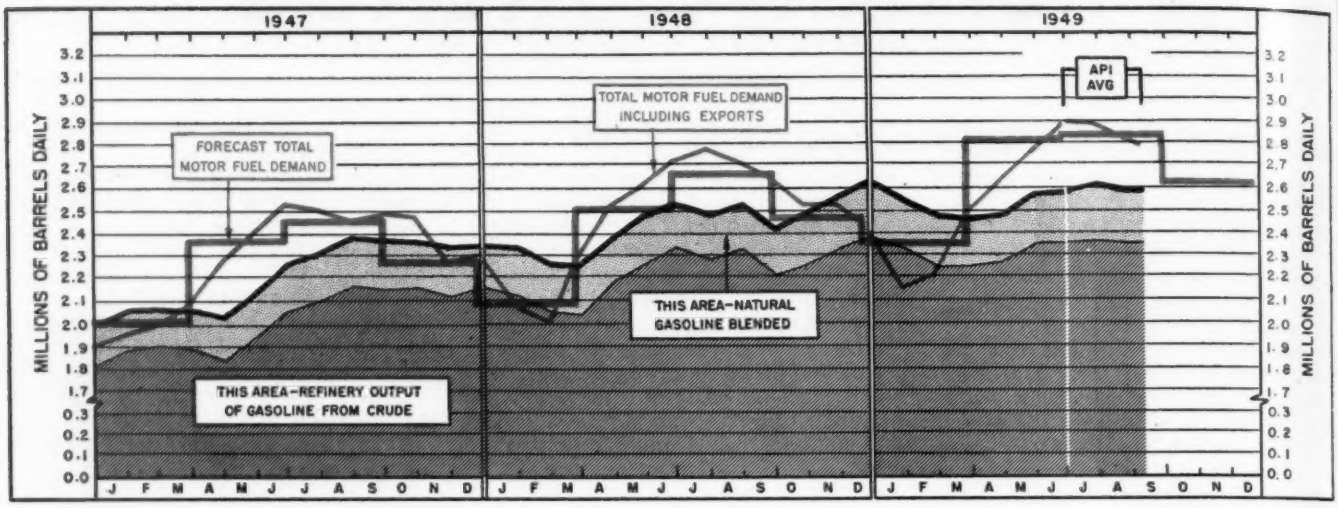
	Crude Run to Stills			Gasoline Production			Distillate Production			Residuals		
	Domestic	Foreign	Total	From Crude	Natural Gasoline	Total	Kerosine	Distillate	Total	Refinery Prod.	Imports	Totals
Sept., 1949, b/d avg.*.....	4,856,000	387,000	5,243,000	2,359,000	235,000	2,594,000	266,000	933,000	1,196,000	1,090,000	150,000	1,240,000
Sept., 1948, b/d avg.	4,985,000	391,000	5,376,000	2,217,000	199,000	2,416,000	309,600	961,300	1,270,900	1,153,800	144,400	1,298,200
Change in 1949, b/d	—129,000	—4,000	—133,000	+142,000	+36,000	+178,000	—43,600	—28,300	—74,900	—63,800	+5,600	—58,200
	(—2.6%)	(—1.0%)	(—2.5%)	(+6.4%)	(+18.1%)	(+7.4%)	(—14.1%)	(—2.8%)	(—5.9%)	(—5.5%)	(+3.9%)	(—4.5%)
7 Mos., 1949, 1000 bbls.**..	1,038,734	85,931	1,124,665	543,488	81,867	625,355	57,317	189,786	247,103	251,415	34,107	285,522
7 Mos., 1948, 1000 bbls.....	1,110,333	63,885	1,174,218	525,486	82,694	608,180	72,023	219,641	291,664	275,071	31,869	306,940
Change in 1949, 1000 bbls...	—71,596	+12,046	—49,553	+18,002	—827	+17,175	—14,706	—29,855	—44,561	—23,656	+2,238	—21,418
	(—6.4%)	(+18.9%)	(—4.2%)	(+3.4%)	(—1.0%)	(+2.8%)	(—20.4%)	(—13.6%)	(—15.3%)	(—8.6%)	(+7.0%)	(—7.0%)

*Through Sept. 10, 1949, only. **July figures estimated from API reports.

Summary of Statistics on Natural Gasoline

	Production, b/d			Consumption, b/d			End-of-Month Inventories, bbls.		
	Propane & Butane	Heavier Naturals	Total	Blended at Refineries	Supplied Direct As Motor Fuel	Sold as LPG for Fuels, Chemicals	Refineries	Gasoline Plants	Total
July, 1949	140,100	261,900	402,000	234,000	45,000	99,000	2,194,000	5,384,000	7,578,000
July, 1948	125,200	256,800	382,000	198,000	80,000	97,000	1,899,000	4,277,000	6,176,000
7 Mos., 1949	32,691,000	54,359,000	87,050,000	47,593,000	11,949,000	24,125,000	.....	.....	.....
7 Mos., 1948	30,205,000	52,489,000	82,694,000	43,027,000	11,606,000	23,118,000	.....	.....	.....

Fig. 2—Gasoline Supply, Demand and Forecast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MILLIONS OF BARRELS DAILY
FORECAST TOTAL MOTOR FUEL DEMAND
TOTAL MOTOR FUEL DEMAND INCLUDING EXPORTS
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THIS AREA-NATURAL GASOLINE BLENDED
THIS AREA-REFINERY OUTPUT OF GASOLINE FROM CRUDE
J F M A M J J A S O N D

The motor fuel demand line and the forecast demand line include, in addition to refinery gasoline and natural gasoline blended at refineries, a varying volume of natural gasoline used direct as motor fuel. This volume averages around 70,000 b/d.

Fig. 3—Gasoline Stocks

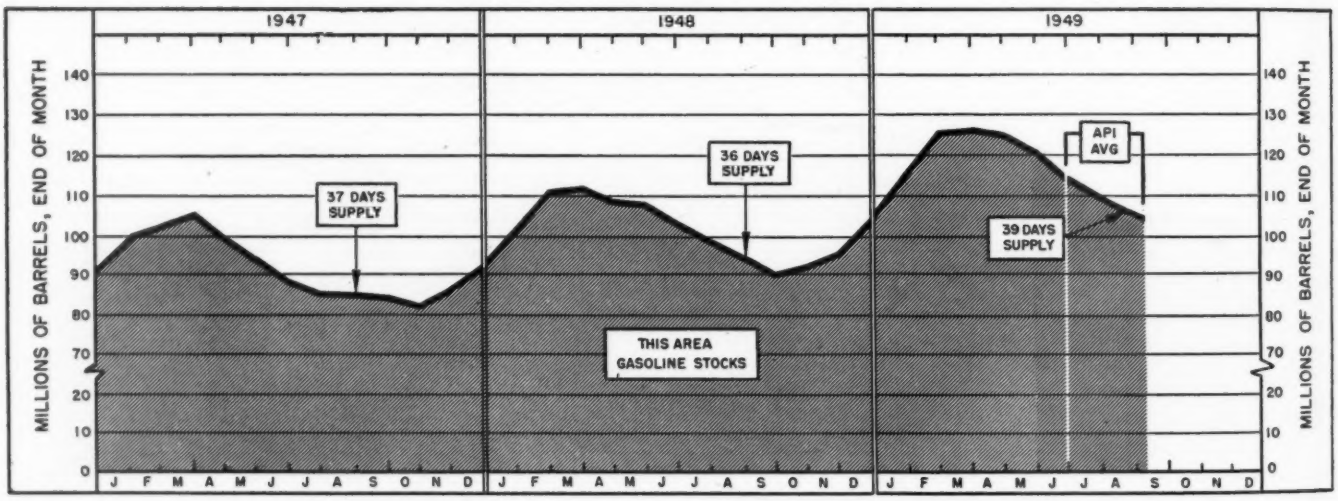
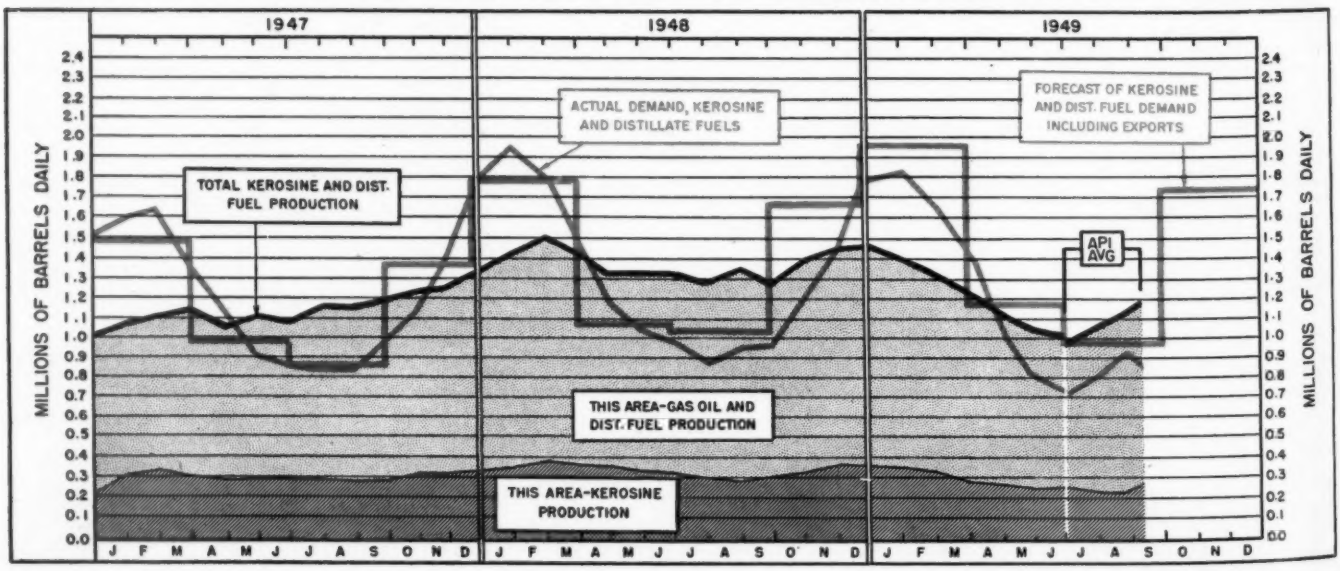


Fig. 4—Kerosine and Distillate Fuel Oil Supply, Demand and Forecast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FORECAST OF KEROSINE AND DIST. FUEL DEMAND INCLUDING EXPORTS
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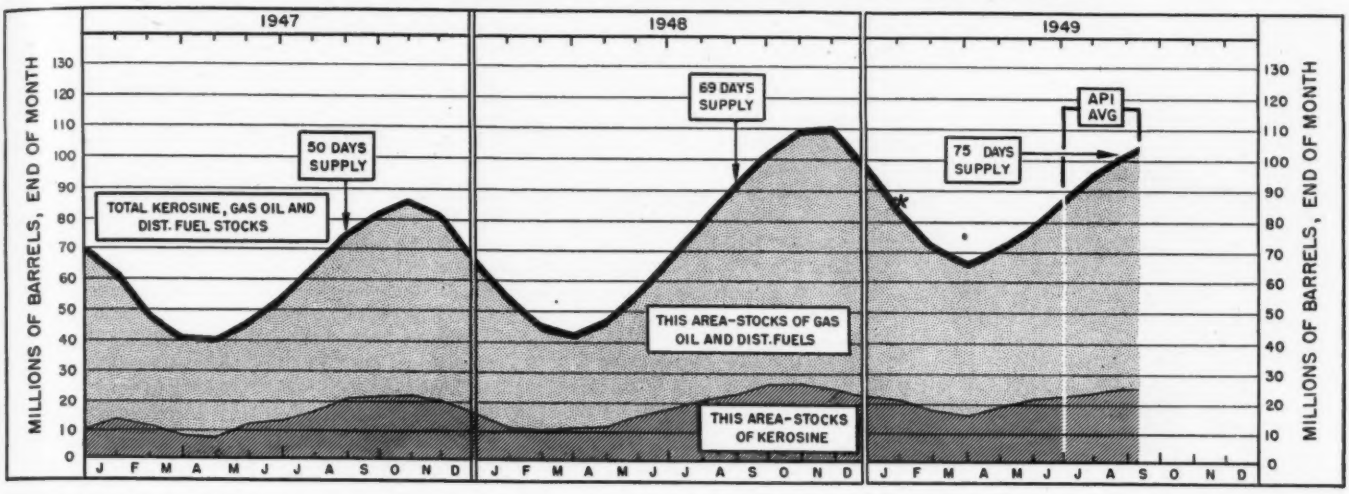
THIS AREA-KEROSINE PRODUCTION
J F M A M J J A S O N D

Fig. 5—Kerosine and Distillate Fuel Oil Stocks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1948
1949
MILLIONS OF BARRELS, END OF MONTH
50 DAYS SUPPLY
TOTAL KEROSINE, GAS OIL AND DIST. FUEL STOCKS
69 DAYS SUPPLY
THIS AREA-STOCKS OF GAS OIL AND DIST. FUELS
THIS AREA-STOCKS OF KEROSINE
75 DAYS SUPPLY
API AVG
J F M A M J J A S O N D

* About 5,000,000 bbls. of the drop in kerosine and distillate stocks shown in January, 1949, is due to a difference in reporting adopted in California, where cracking stocks were dropped from this classification.

Fig. 6—Residual Fuel Oil Supply, Demand and Forecast

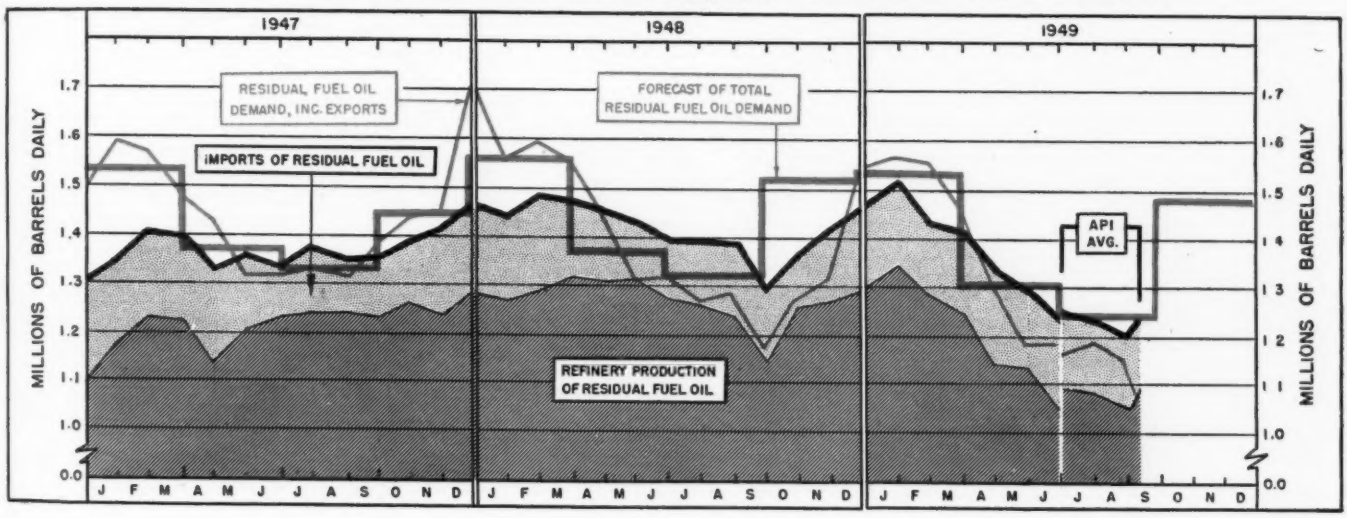
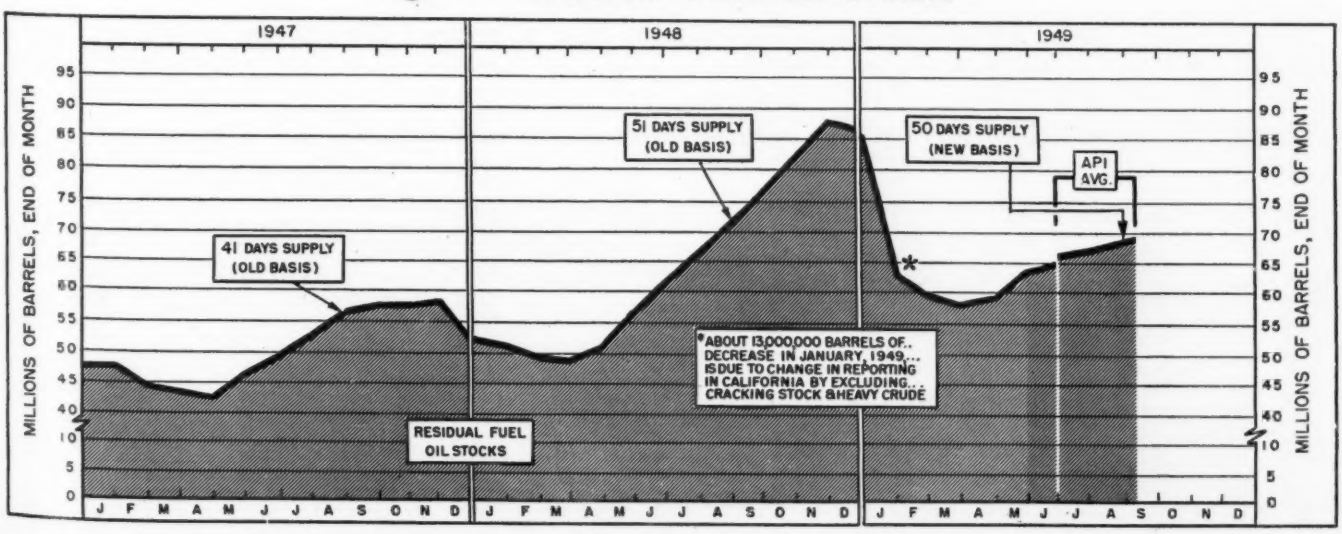

1947
1948
1949
MILLIONS OF BARRELS DAILY
RESIDUAL FUEL OIL DEMAND, INC. EXPORTS
IMPORTS OF RESIDUAL FUEL OIL
FORECAST OF TOTAL RESIDUAL FUEL OIL DEMAND
REFINERY PRODUCTION OF RESIDUAL FUEL OIL
API AVG.
J F M A M J J A S O N D

Fig. 7—Residual Fuel Oil Stocks


1947
1948
1949
MILLIONS OF BARRELS, END OF MONTH
41 DAYS SUPPLY (OLD BASIS)
51 DAYS SUPPLY (OLD BASIS)
50 DAYS SUPPLY (NEW BASIS)
API AVG.
*ABOUT 13,000,000 BARRELS OF.. DECREASE IN JANUARY, 1949,... IS DUE TO CHANGE IN REPORTING IN CALIFORNIA BY EXCLUDING... CRACKING STOCK & HEAVY CRUDE
RESIDUAL FUEL OIL STOCKS
J F M A M J J A S O N D

* Residual fuel oil stocks July 31, 1949, (API data) new basis, 67,183,000 bbls. Stocks July 31, 1948, old basis, 66,262,000 bbls: July 31, 1947, 52,808,000 bbls.

Fig. 8—Production of Natural Gasoline and Production Forecast

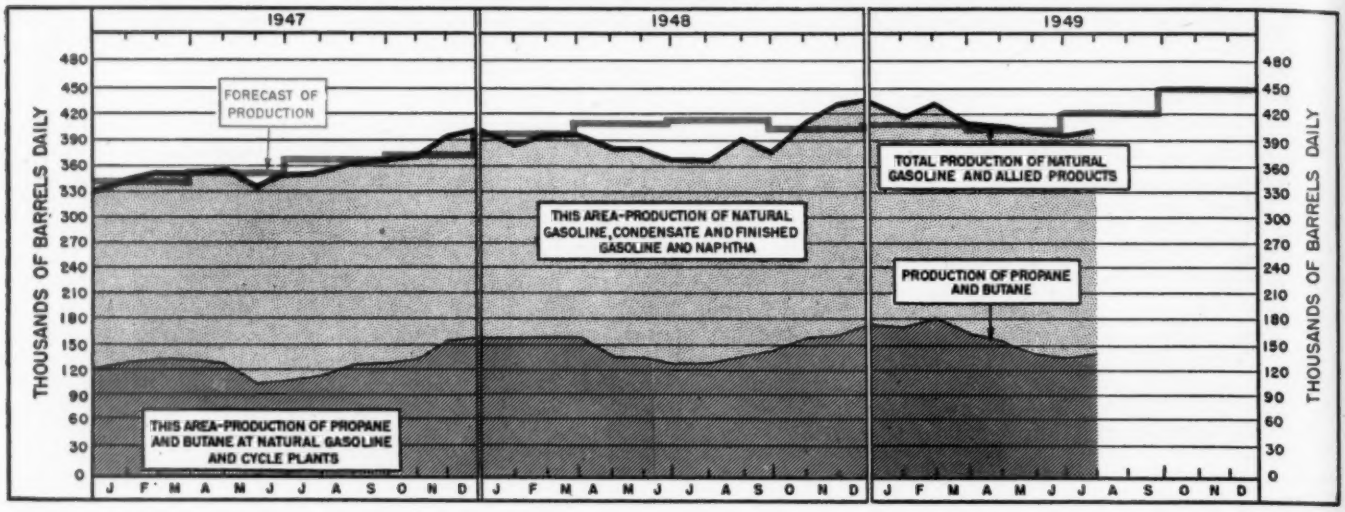

1947
1948
1949
THOUSANDS OF BARRELS DAILY
FORECAST OF PRODUCTION
THIS AREA-PRODUCTION OF NATURAL GASOLINE, CONDENSATE AND FINISHED GASOLINE AND NAPHTHA
TOTAL PRODUCTION OF NATURAL GASOLINE AND ALLIED PRODUCTS
PRODUCTION OF PROPANE AND BUTANE
THIS AREA-PRODUCTION OF PROPANE AND BUTANE AT NATURAL GASOLINE AND CYCLE PLANTS
J F M A M J J A S O N D

Fig. 9—Stocks of Natural Gasoline and Allied Products

(Days supply figured in terms of current demand)

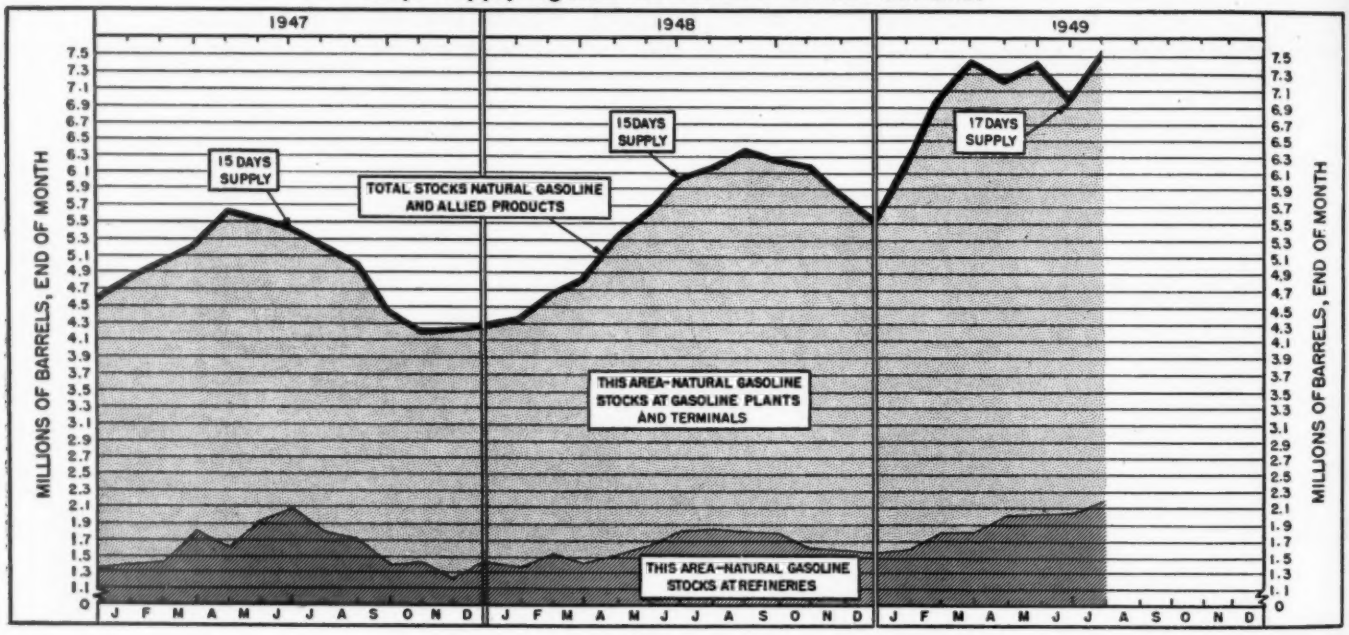
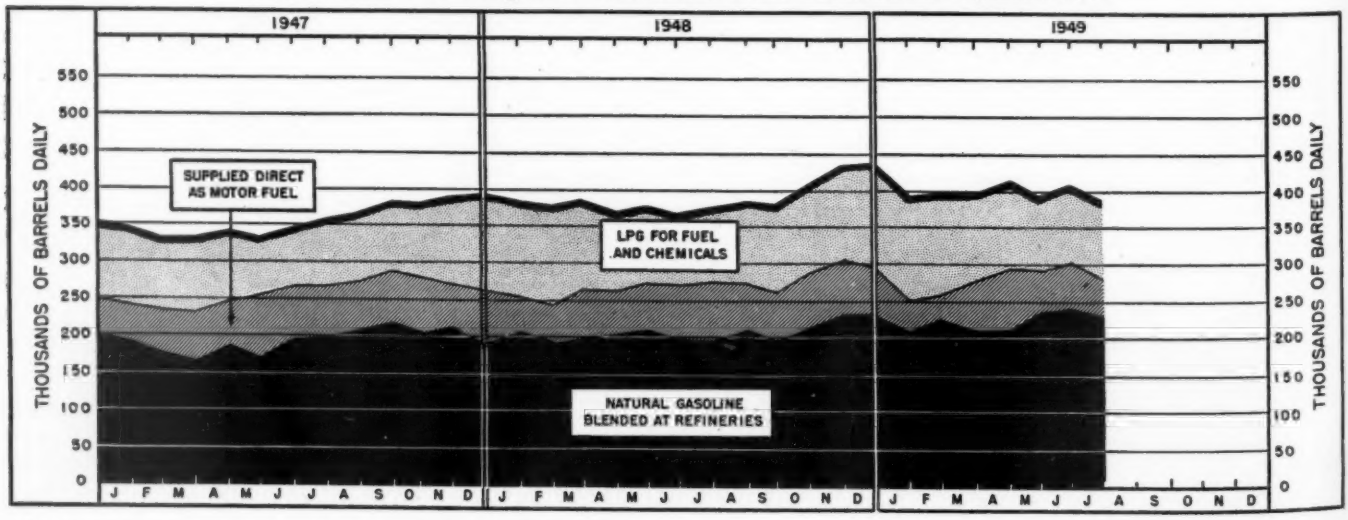
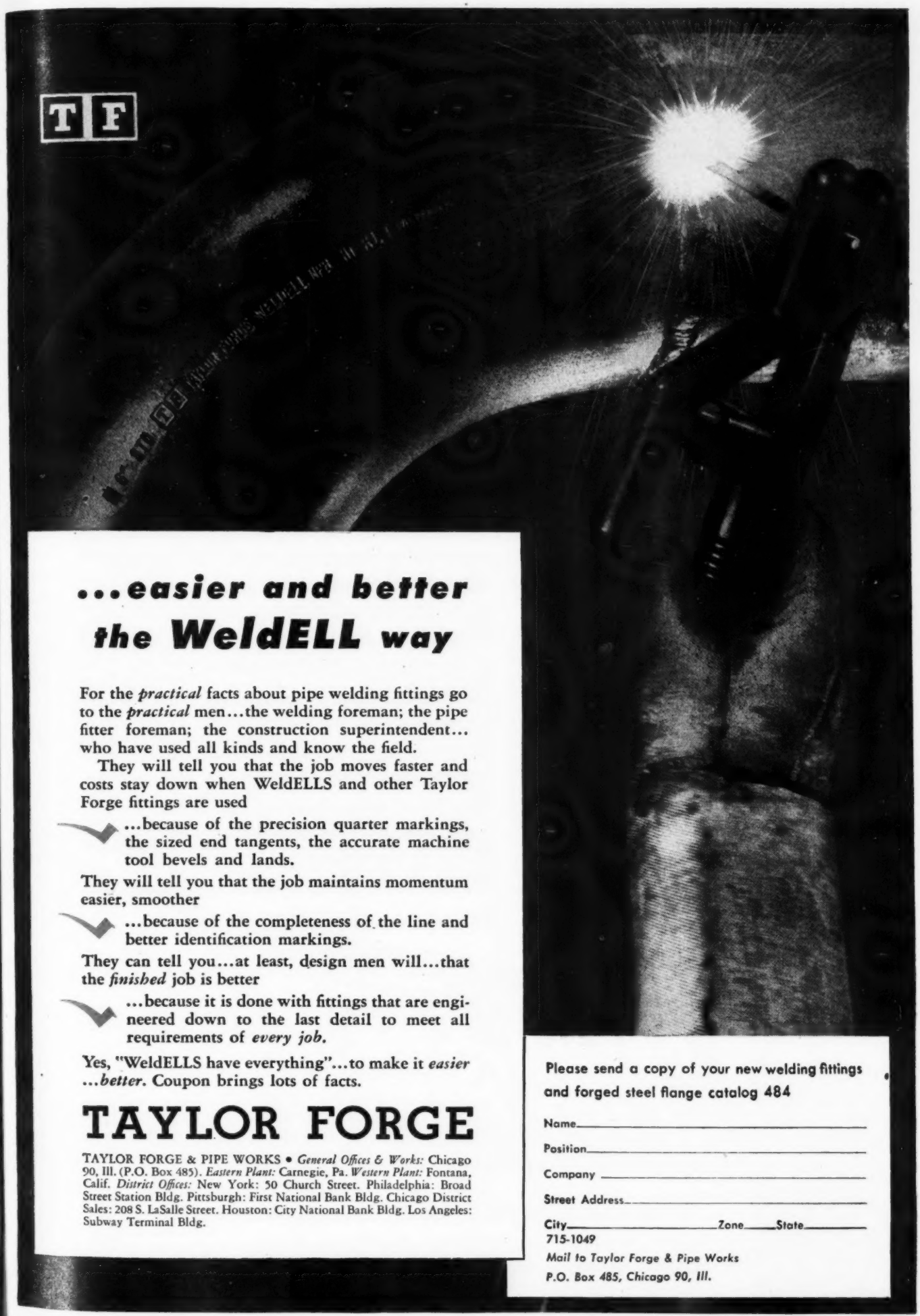

1947
1948
1949
MILLIONS OF BARRELS, END OF MONTH
15 DAYS SUPPLY
TOTAL STOCKS NATURAL GASOLINE AND ALLIED PRODUCTS
15 DAYS SUPPLY
17 DAYS SUPPLY
THIS AREA-NATURAL GASOLINE STOCKS AT GASOLINE PLANTS AND TERMINALS
THIS AREA-NATURAL GASOLINE STOCKS AT REFINERIES
J F M A M J J A S O N D

Fig. 10—Principal Demand for Natural Gasoline


1947
1948
1949
THOUSANDS OF BARRELS DAILY
SUPPLIED DIRECT AS MOTOR FUEL
LPG FOR FUEL AND CHEMICALS
NATURAL GASOLINE BLENDED AT REFINERIES
J F M A M J J A S O N D



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- STANDARDIZATION
- PORTABILITY
- ACCESSIBILITY OF PARTS
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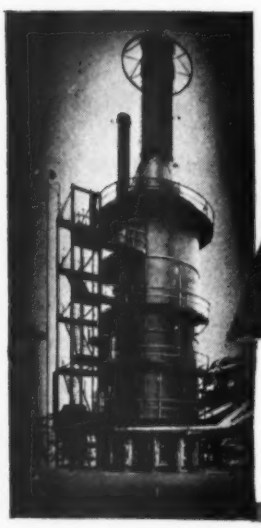

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Personals

E. W. Luster has been appointed manager of the Esso Engineering Dept. of Standard Oil Development Co., central research affiliate of Jersey Standard. He succeeds **Dr. N. E. Loomis,** who retains his position as vice president of the Development Co. while relinquishing his duties as department manager in order to devote more attention to general policy matters.

Mr. Luster

C. E. Paules, formerly associate chief engineer, succeeds Mr. Luster as chief engineer with responsibility for the general supervision of the department.

Mr. Luster, a native of Elizabeth, N. J., is a graduate of Rutgers University. He joined Jersey Standard in 1916, and the Development Co. in 1928. Mr. Paules, born in Marietta, Pa., was graduated from Lehigh University. He joined Jersey in 1919, and also transferred to the Development Co. in 1928.

* * *

Frank V. Moore, Jr., chemical engineer with Pan American Refining Corp. at Texas City, Texas, has been named assistant head of the operating department.

* * *

Julius D. Heldman has been named general program advisor to the research director at Shell Oil Co.'s research laboratory at the Houston refinery. Mr. Heldman was formerly chief research chemist at Shell's Wilmington, Calif., laboratory. He joined the company as a technologist in 1945, was formerly an instructor at the University of California, and received his doctor's degree from Stanford University in 1942.

* * *

George S. Smith, formerly an operating engineer at the Elk Basin plant in Park County, Wyo., operated by Stanolind Oil and Gas Co., has been named plant engineer. He joined Stanolind in 1945.

* * *

Several promotions have been announced at Stanolind Oil and Gas Co.'s research laboratory in Tulsa. **Charles E. Buffum,** formerly construction and technical service section supervisor, has been named research group supervisor. He joined Stanolind in 1934. **Ralph E. Hartline** has been advanced to the position of research group supervisor. He was previously a senior research engineer, and has been with Stanolind since 1943. **Harold M. Lang** is now senior research engineer, advancing from the position of instrument shop supervisor. He came with Stanolind in 1935.

* * *

G. Elizabeth Wilson, chemist at the Pt. Arthur works of the Texas Co., has resigned and entered the University of Kansas, where she will hold an assistantship while doing graduate work.

* * *

Frederick Fahnoe has joined the staff of the chemistry department of Kellex Corp., at its Jersey City laboratory. As an industrial chemist he specialized in experimental plant design and acetylene chemistry research.

* * *

Forrest F. Musgrave, technical assistant to Kent H. Smith, president of Lubrizol Corp., Wickliffe, Ohio, sailed to England at the end of August, where he will take over the responsibilities of managing director, Anglamol Ltd., a British subsidiary of Lubrizol. Dr. Musgrave, a graduate of Oxford as a Rhodes scholar in 1933, has been associated with Lubrizol since 1941. Prior to that he was with Imperial Oil at Halifax, Toronto, and Sarnia, in refinery control and research.

Art Willey, vice president in charge of engineering at Lubrizol, is vice-president elect for 1950 for the Fuels & Lubricants Section, Society of Automotive Engineers. During the war, Mr. Willey was a consultant to the Army Ordnance Dept. on lubrication and participated in the activities of the CRC. He is a member of SAE, American Petroleum Institute, American Society of Mechanical Engineers, American Society for Testing Materials, and American Society of Lubrication Engineers.

* * *

Howard B. Nichols, vice president in charge of refining of Bahrein Petroleum Co., Ltd., has been named a director of the company, and also a director, vice president and member of the executive committee of California Texas Oil Co., Ltd. Mr. Nichols, a graduate of Stanford University, has been connected with petroleum refining since 1923. He assisted in the design of Bahrein's refinery on the Persian Gulf before joining the firm in 1938, when he became manager of research and development. He was elected an assistant vice president in 1944 and a vice president in 1947.

* * *

George F. L. Bishop, formerly assistant to the vice president of Alamo Refining Co. in Houston, has joined Phillips Oil Co. as superintendent of the Okmulgee, Okla., refinery. Both Alamo and Phillips Oil are subsidiaries of Phillips Petroleum Co.

* * *

Dr. Stanley Chaberek, Jr. has joined the research staff of the Houdry Process Corp. at its laboratories in Linwood, Pa. His position is that of Assistant Research Chemist. Dr. Chaberek comes direct to Houdry from Clark University in Worcester, Mass., where he was awarded his doctor's degree in chemistry in August of this year.

* * *

Joe Miller, formerly assistant gas superintendent for Humble Oil & Refining Co., has been appointed to a newly-created position as coordinator of supply and sales of light hydrocarbons. He will coordinate supply, distribution and sales of propane, butane and other light hydrocarbons being produced at Humble's Baytown refinery and at natural gasoline and cycling plants over a wide area. Mr. Miller joined Humble's gas division in 1925 after being graduated from Texas A. & M.

Mr. Miller

* * *

George W. Nigh, Tide Water Associated Oil Co., has been elected chairman of the metropolitan section of the American Society of Mechanical Engineers. He is asst. mechanical superintendent at Tide Water's Bayonne, N. J., refinery.

* * *

J. E. Bogk has been appointed vice chairman of the operating committee of Phillips Petroleum Co. Previously he was manager of the refining department with headquarters in Bartlesville. Mr. Bogk joined Phillips as chief engineer of the Kansas City, Kansas, refinery in 1929, and has been with the company's refining department ever since.

* * *

Gregory M. Hebert has joined the technical staff, Paramins division, of Enjay Co., affiliate of Jersey Standard. He was formerly with Standard Oil Development Co., Jersey's central technical organization, engaged in research and field testing of lubri-

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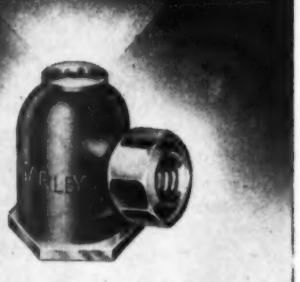

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KANSAS CITY 15, KANSAS

cants and fuels. A graduate of civil engineering of the University of Illinois, Mr. Hebert served as lieutenant-commander with the Navy during the war, and prior to that was with Carter Oil Co. from 1938 to 1942.

* * *

Dr. Bruce H. Stage, professor of chemical engineering at California Institute of Technology, has been named winner of the first $1000 Precision Scientific Co. award in petroleum chemistry, and will receive the award at the Sept. 19 annual meeting of the ACS in Atlantic City.

* * *

A. E. Higgs has been named superintendent of the Casper, Wyoming, refinery of The Texas Co., succeeding **Pendleton Beall,** who has retired. Mr. Higgs was formerly superintendent of the company's refinery at San Antonio, Texas.

H. C. Wakefield, former asst. superintendent at the Casper plant, is being moved to El Paso, Texas, as head of Texaco's refinery there. His place at Casper is being filled by **E. W. McNealy** from the company's process engineering department in New York.

* * *

Harry A. Brown is now vice president in charge of manufacturing for Frontier Refining Co. He joined the firm in 1946, and became superintendent of Frontier's Cheyenne, Wyoming, refinery. Previously he had been with Universal Oil Products Co.

* * *

G. Clifford Johnson has been named superintendent in charge of mechanical departments at Sun Oil Co.'s Marcus Hook, Pa., refinery. He previously served as assistant superintendent in charge of maintenance and construction.

* * *

W. A. McMillan has been named asst. director of research at the Beacon, N. Y., research center of The Texas Co.

* * *

Edward D. Alvord, Jr., is a junior engineer for Standard Oil Co. (Ohio) in Cleveland.

* * *

Glenn Purcell is now asst. superintendent at Shell Chemical Corp.'s Houston plant. He was formerly senior technologist in Shell Oil Co.'s head office manufacturing department.

* * *

Gerald L. Wood has joined Shell Oil Co. in San Francisco as a junior mechanical engineer.

Corrections—Antifreezes

Several errors in the article "Antifreezes from Petroleum" published in PETROLEUM PROCESSING for January 1949 (vol. 4, no. 1, pp. 43-49) have been called to our attention by readers:

Table 2 (pg. 44): The column headed "Ethanol-Water" should be "Methanol-Water," and the column headed "Methanol-Water" should be "Ethanol-Water." Also, the correct reference for this table is (14), not (1).

Table 4 (pg. 48): The data are given in terms of 1,000 U. S. Gallons, not 100,000 U. S. Gallons. Also, the 1947-48 total in this table should be "79,000," not "70,000."

MEETINGS
. . . for the Oil Man

OCTOBER

10-14, American Society for Testing materials, First National West Coast Meeting, Fairmont Hotel, San Francisco.

14, Natural Gasoline Assn. of America, Southern Regional Meeting, Blackstone Hotel, Tyler, Texas.

15-21, American Society for Metals, 31st Annual National Metal Exposition and Congress, Public Auditorium, Cleveland.

17-21, American Welding Society, Annual Meeting, Public Auditorium, Cleveland.

20-21, American Institute of Mining & Metallurgical Engineers, Fall Meeting, Petroleum Branch, Elk's Club, Los Angeles.

21, Western Petroleum Refiners Assn., Regional Technical Meeting, Palmer House, Chicago.

25, Association of Consulting Chemists and Chemical Engineers, 22nd Annual Dinner Meeting, Shelburne Hotel, New York.

26-27, American Society of Mechanical Engineers, Fuels Division Conference, French Lick Springs Hotel, French Lick, Ind.

NOVEMBER

1-5, 2nd Pacific Chemical Exposition and Pacific Industrial Conference, Civic Aud., San Francisco.

3-4, Society of Automotive Engineers, Fuels & Lubricants Meeting, Chase Hotel, St. Louis, Mo.

4-5, The Society of Rheology, 20th Annual Meeting, Hotel New Yorker, New York.

7-10, American Petroleum Institute, Annual Meeting, Stevens Hotel, Chicago.

17, American Institute of Chemical Engineers, Third Annual Fall Symposium of New York Section, Hotel Statler, New York.

27-Dec. 2, American Society of Mechanical Engineers, Annual Meeting, Hotel Statler, New York.

28-Dec. 3, 22nd Exposition of Chemical Industries, Grand Central Palace, New York.

DECEMBER

4-7, American Institute of Chemical Engineers, Annual Meeting, William Penn Hotel, Pittsburgh.

9, Natural Gasoline Assn. of America, Panhandle-Plains Regional Meeting, Herring Hotel, Amarillo, Texas.

9, American Chemical Society, Southwest Regional Meeting, sponsored by Oklahoma Sections, Oklahoma City.

29-30, American Chemical Society, Division of Industrial and Engineering Chemistry, Columbus, Ohio.

JANUARY, 1950

9-13, Society of Automotive Engineers, Annual Meeting and Engineering Display, Book-Cadillac Hotel, Detroit.

16-19, First Plant Maintenance Show, Public Auditorium, Cleveland.

FEBRUARY, 1950

26-Mar. 1, American Institute of Chemical Engineers, Regional Meeting, Rice Hotel, Houston.

27-Mar. 3, American Society for Testing Materials, Committee Week and Spring Meeting, Pittsburgh.

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EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

Can We Believe What Bureau Says In Its Synthetic Fuels Reports?

IT IS unfortunate in many respects that the Bureau of Mines scientific investigation of oil shales as a potential source of liquid fuels has been subverted to a source for propaganda for a government-subsidized synthetic liquid fuels industry. The public is being misled to believe that the making of motor fuel and other products in tremendous volume from oil shale is now practicable, at prices competitive with petroleum products.

The "news" that has been released during the past month on the oil shale project in Colorado is so distorted that it is to be questioned if science and industry can accept with full credence the final reports when they are issued. Complete, unbiased data, covering a wide field of research on the subject, is necessary for an accurate evaluation of this possible source of synthetic fuel. It is unfortunate also that men in science and industry should have to question the motives in research work carried on directly by government agencies. And this at a time when it is proposed that government assume a larger role in the conduct and sponsoring of research through a National Science Foundation.

New propaganda for the Bureau's shale oil project was put over in the form of "planted" articles, widely published in newspapers, in order to focus public attention on the demonstrations of the Rifle experimental units the latter part of September. It was stated in the articles that the feasibility of handling crude oil extracted from shale has been proved in the 200-bbl. refinery there, which only started operating in July.

This statement is the opposite of the experience of some of the oil companies which have experimented in processing the shale oil from the Rifle experimental retorting unit. This oil, like any crude, has to be suitable for catalytic cracking in order to make motor fuel of the required octane rating for today. Thus far what has been learned by the oil companies is that the nitrogen compounds in the shale crude are absorbed by the catalyst at a rate that greatly reduces its efficiency. Accumulation of coke on the catalyst is much heavier than with stocks from natural crude, and much higher operating temperatures are required. Again, Diesel fuel cuts from the shale oil are said to require hydrogenating to secure a suitable cetane number.

One article credits a Bureau engineer with claiming that the processing of shale oil is "no more expensive" than the refining of natural petroleum. Contrast this statement with a recent study by the managers of Stanolind Oil & Gas Co.'s research and economics departments. They have calculated that a shale oil refinery would require about three times the investment needed for a conventional oil refinery, and that direct processing costs would be about 7.0c per gallon of gasoline produced as compared with 2.8c per gallon of equivalent gasoline from crude.

A favorite trick of the Bureau's synthetics staff—one which might explain how they arrive at "no more expensive" estimates—is to figure costs on the basis of non-profit operation, and therefore with no allowance for Federal income taxes, and to take full credit for all by-product chemicals, regardless of what effect a sudden surplus of these chemicals would have on their market price. How this practice can distort figures is readily apparent in a Bureau report on coal hydrogenation costs. In the introductory remarks of the report the Bureau claims a cost of as low as 8.0c per gallon. If the report is studied in detail, however, byproduct chemical credits discounted, and a 3% return on plant cost added, the 8.0c figure jumps to 14.3c. Needless to say, it is the lower figure which gets publicized most by the Bureau's press agents.

Despite the present abundance of crude supplies for our foreseeable needs, the Federal Interior Department and its Bureau of Mines continue to lobby in Washington and through the country's newspapers, pressing for a synthetic liquid fuels industry. If Congress can be "sold" on the proposition hundreds of millions will be voted for synthetic fuels plants.

And congress will be sold unless those individuals in our industry who can command attention speak up and refute the half-true and unjustified claims the Bureau tosses about with abandon.

Thoughts on an ACS Meeting

AMERICAN Chemical Society meetings always attract a broad cross-section of the chemical and chemical engineering personnel of the petroleum processing field, both to sessions of the Division of Petroleum Chemistry and to those of related divisions.

It is not surprising, then, to note that petroleum chemists are also active in the field of the chemical literature, as involved in the functioning of the ACS's newly formed Division of Chemical Literature. One officer of this division recently remarked that whenever he sought assistance in some phase of the division's activities, two out of three volunteers were from the petroleum field. Official cognizance of the need for efficient use of information has long been a petroleum industry asset, and even inside the ACS the "Petroleum Division" has several times participated in joint sponsorship of symposia in this field.

That it is no longer a simple matter to ferret out facts from the pyramiding files of chemical and technical literature was clearly evident at the ACS meeting from the emphasis placed on codes, classification systems, machine sorting, microfilms and microcards, and similar devices. It is of vital importance to the petroleum industry that those charged with the provision of needed information keep abreast of developments in this rapidly advancing field, so that data published in journals such as PETROLEUM PROCESSING may effectively serve their dual purpose—to inform currently and to serve as background data when needed later.

Meetings such as those of the ACS serve many purposes—not the least of which is to remind workers that there is a petroleum *industry*, not just a group of companies completely disinterested in each others welfare.

—B. H. W.

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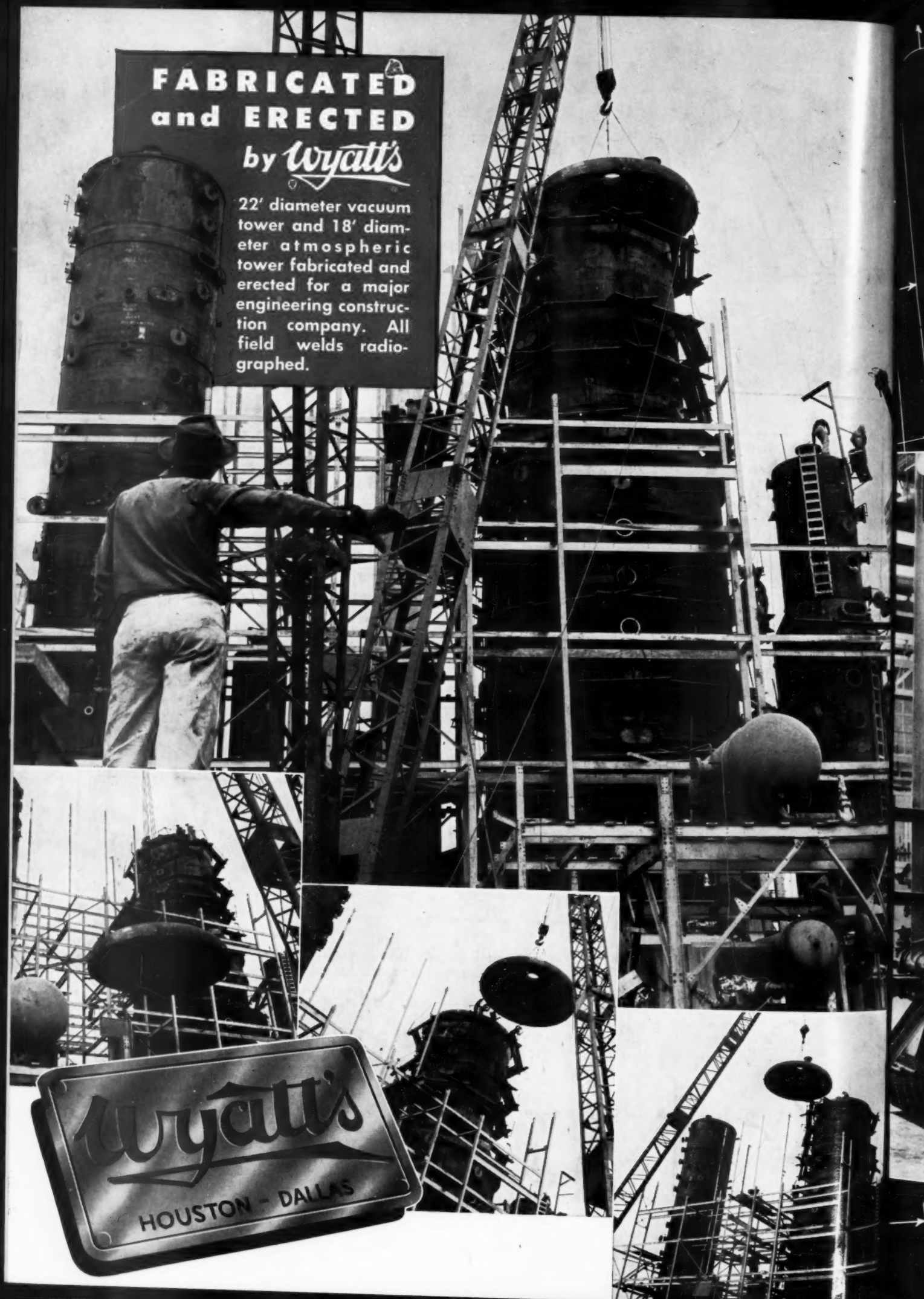
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